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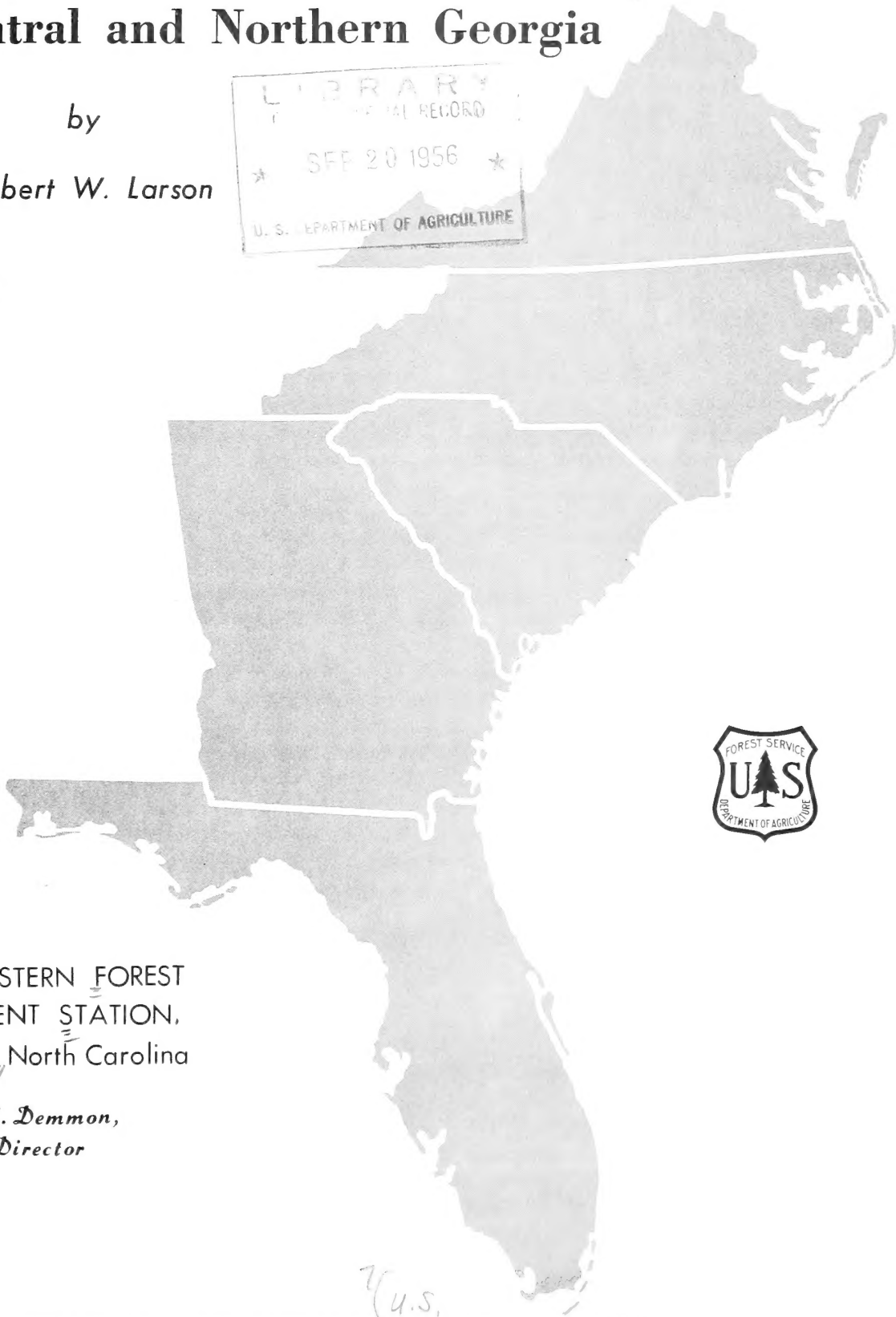
Hardwood Timber Resources in Central and Northern Georgia

by

Robert W. Larson



SOUTHEASTERN FOREST EXPERIMENT STATION,
Asheville, North Carolina

E. L. Demmon,
Director

U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE

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The purpose of this report is to bring together from the Forest Survey detailed information on the makeup and use of the hardwood resource of central and northern Georgia. This information was particularly needed in the planning of a new research project on the management of Piedmont hardwoods at the Athens-Macon Research Center. It should also be of direct interest to the many foresters and forest industries whose future is tied in with the hardwood resources of the area.

Grateful acknowledgment is made to Dr. Thomas C. Nelson and other personnel of the Athens-Macon Research Center for summarization of data on which many of the charts in this publication are based; also to the Graphics Unit, National Weather Records Center, Weather Bureau, U. S. Dept. of Commerce, Asheville, N. C., for drafting the charts and maps.

HARDWOOD TIMBER RESOURCES IN CENTRAL AND NORTHERN GEORGIA

By

Robert W. Larson

INTRODUCTION

A belt of gently rolling hills, known as the Piedmont plateau, separates the rugged Appalachian mountain range from the low, level plain along the Atlantic and Gulf coast (fig. 1). The rolling nature of the land, along with heavy rainfall and a long winter period during which the land is left without the protection of growing vegetation, makes the soils especially susceptible to erosion and loss of fertility. Since settlement began, it has been a common practice to crop a field for several years until yields began to drop, abandon it, and clear new land. A large share of the land in this region has gone through at least one cycle of clearing, abandonment, and reversion to forests. There probably is very little land outside of the swales and swampy river bottoms which at some time or another in the past has not been cropped.

After this region became settled, the amount of land in agriculture did not fluctuate a great deal; land clearing tended to balance land abandonment. But following the Civil War, the depression of the 1880's, and the boll weevil invasion of the cotton fields in the early 1920's, land abandonment far exceeded land clearing. Agricultural land shrank and forest land increased.

Much of the agricultural land allowed to revert to forest during these periods of widespread abandonment never was returned to agriculture, and the area of forest land has continued to increase up to the present time. Every year during the past 15 to 20 years, forests have invaded over a fourth of a million acres in the Piedmont regions of Virginia, North Carolina, South Carolina, and Georgia. In 1953 forests covered 68 percent of the total land area, compared to 56 percent in 1936.

While hardwood forests made up of oaks, hickory, gum, and yellow-poplar originally covered most of this region, pines rather than hardwoods invade the abandoned fields. Thus, the immediate result of wide-scale land abandonment is a big increase in the area of pine type. Hardwood species, however, soon make their appearance in the understory of the pine stands. On the hot, dry southern slopes and ridges, which are not especially well suited to the growth of hardwoods, hardwoods replace pine slowly. But on the northern slopes, especially on the deep, moist soils, an understory of almost pure hardwoods has frequently become established by the time the pine is large enough to cut.

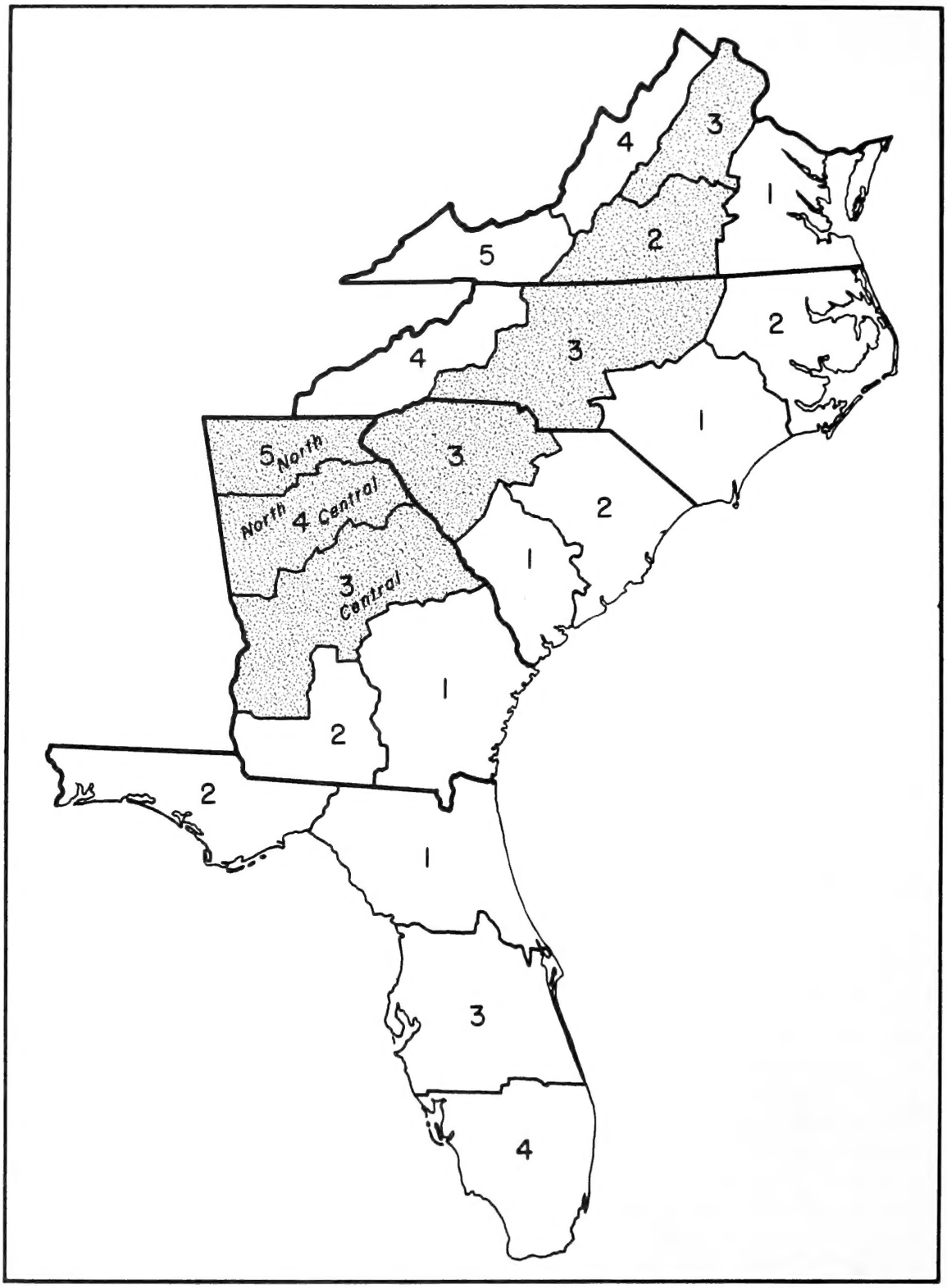


Figure 1.--Location of the Piedmont Forest Survey Units in Virginia, North Carolina, South Carolina, and Georgia.

This conversion of pine to hardwood stands is hastened by repeatedly cutting out the pine and leaving the hardwoods. Since 1936, the area of hardwood type has increased by about 5 million acres, while the area of pine type has remained about the same, in spite of wide-scale seeding in of pine on abandoned farmland. The proportion of hardwood type has increased from about 30 percent in 1936 to 42 percent in 1953. Prevailing cutting practice not only hastens the conversion of pine stands to hardwoods but reduces the quality of timber. The best quality hardwoods are usually cut along with the pine, leaving stands choked with the less desirable species and short, limby, crooked and rotten culls. Thus, forest industries dependent upon this region for their timber supply are faced with an ever-increasing volume of low-grade hardwoods for which they have little or no use. Timber landowners are confronted with an ever-increasing volume of this unsalable timber which is preventing the establishment and growth of the pine and good-quality hardwoods they could sell.

A recent forest survey completed in 1953 provides up-to-date information on timber volume and forest conditions in central and north Georgia. Survey crews examined 6,712 ground plots scattered over 13.1 million acres of forest land in the three northern forest survey units in Georgia. Although the Piedmont plateau makes up the largest part of these survey units, this area also includes parts of the Blue Ridge and Appalachian valleys in the north, and the Sandhills and part of the Coastal plain in the south (fig. 2). These areas differ mainly in their geologic origin; that is, they are not part of the uplifted and dissected plain which forms the Piedmont plateau. However, areas adjoining the Piedmont plateu resemble the Piedmont in forest characteristics. They present the same problems associated with shifts from pine and high-grade hardwoods to low-quality hardwoods. No attempt has been made to separate these areas in analyzing the data.

FOREST AREA AND TYPES

Central and north Georgia contain 13.3 million acres, of which 63 percent is forest. Although it is believed that hardwoods originally covered most of the land, only 4.7 million acres, or 35 percent of the forest land, now supports hardwood types, i.e., stands in which 75 percent or more of the volume is in hardwood trees. About 2.6 million acres are oak-hickory type growing on well drained uplands, while 1.9 million acres are oak-gum-cypress types growing in the wet lowlands and river bottoms. Scrub oak is the principal species on 229,000 acres, most of which is in the Sandhills region (fig. 2). An additional 1.6 million acres, or 12 percent of the forest area, supports oak-pine type, stands in which half to 75 percent of the volume is in hardwood trees.

The trend is toward more forest land, and a greater proportion of the forest area is hardwood types. Between 1936 and 1953, the area of forest land in this area increased 21 percent. Most of this new forest land is abandoned farmland which reverted to forest--mainly pine type. However, this increase in pine type was nearly offset by the reversion of pine type to hardwood on other forest area. While pine types increased less than 2 percent, the area of hardwood types increased 76 percent between surveys--an annual increase of 4.2 percent.

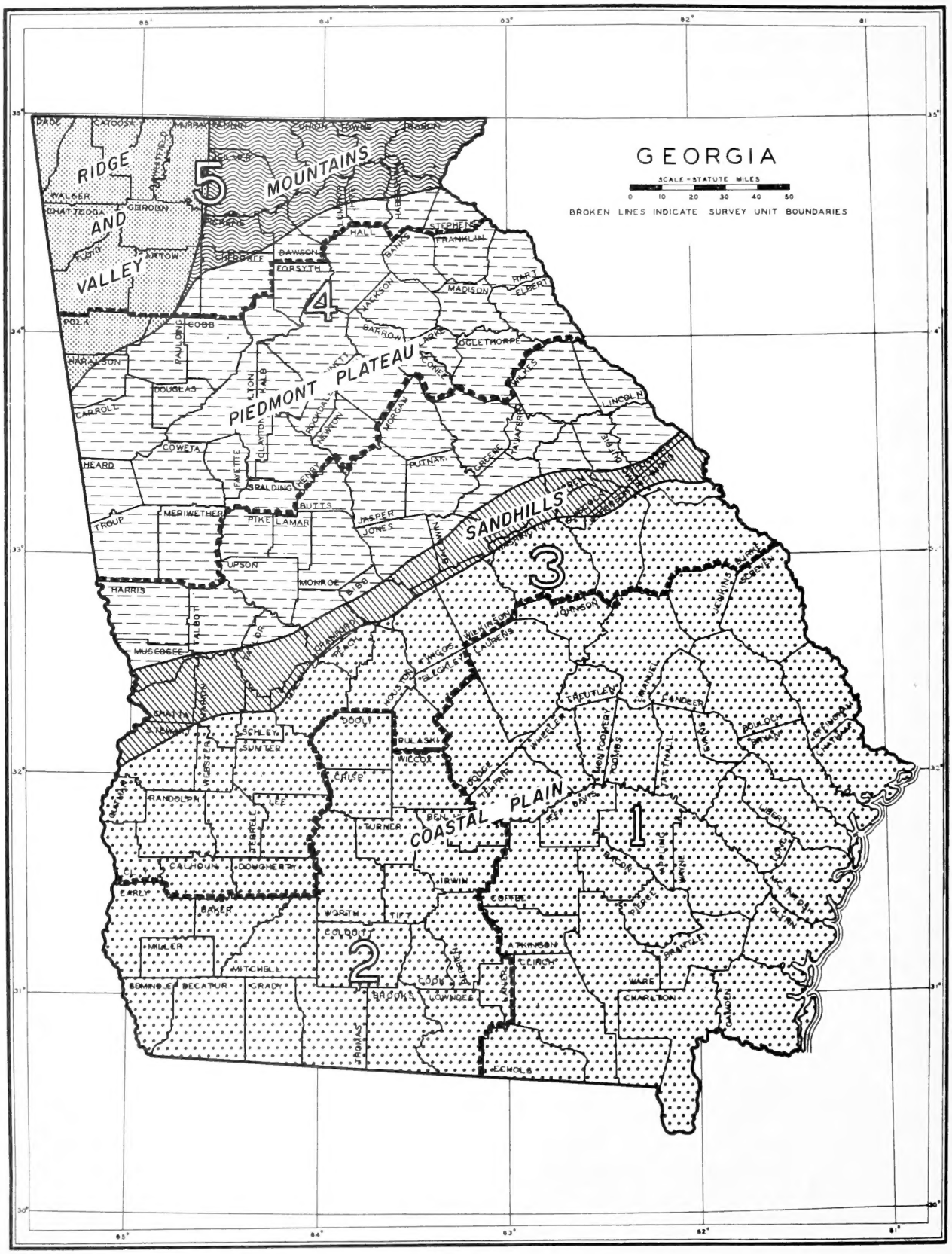


Figure 2.--Geographic provinces and forest survey units in Georgia.

SUPPLY AND USE OF HARDWOODS

Forests of central and north Georgia contain a far greater volume of hardwoods than present industries can possibly use. Hardwood trees contain 71 million cords (table 1), or 59 percent of the total volume including cull timber. Yet they provide only a fifth of the annual cut--nearly all of it from growing stock. [1/] Forty-two million cords, or 59 percent of this volume, is growing stock. Only 29 percent of the gum and yellow-poplar, [2/] and 24 percent of the oak and hickory [3/] is in trees large enough and of high enough quality to make saw logs (fig. 3). Hardwood sawtimber trees, which include trees 11.0 inches and larger having at least one merchantable 12-foot saw log in them, contain 8.4 billion board-feet, or about half the total softwood and hardwood board-foot volume.

Table 1.--Net volume of all hardwood timber by species and class of material

Species	Saw-log portion		Upper stem	Pole timber	Cull timber [1/]	Total	
	Million bd. ft.	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Thousand cords	Percent
Blackgum	1,118.0	2,525	639	2,080	3,009	8,253	11.6
Sweetgum	1,331.4	3,007	757	3,448	2,984	10,196	14.4
Yellow-poplar	914.4	2,006	498	1,460	1,484	5,448	7.7
Soft maple	241.1	555	129	704	2,174	3,562	5.0
Other soft hdwds.	167.8	383	91	373	910	1,757	2.5
Total soft hdwds.	3,772.7	8,476	2,114	8,065	10,561	29,216	41.2
White & swamp chestnut oak	721.0	1,567	419	1,786	1,604	5,376	7.5
Other white oaks	649.0	1,404	359	1,699	3,507	6,969	9.8
Northern red & shumard oak	409.7	845	221	280	826	2,172	3.1
Other red oaks	1,547.7	3,360	886	3,206	5,731	13,183	18.6
Hickory	717.7	1,592	391	1,372	2,238	5,593	7.9
Ash	185.6	443	101	598	707	1,849	2.6
Other hard hdwds.	422.7	961	244	1,323	4,106	6,634	9.3
Total hard hdwds.	4,653.4	10,172	2,621	10,264	18,719	41,776	58.8
All hdwds.	8,426.1	18,648	4,735	18,329	29,280	70,992	100.0

1/ Includes limb volume of hardwood sawtimber trees and volume of noncommercial species.

1/ Growing stock is volume in trees 5.0 inches and larger which are either now suitable for saw logs or show promise of becoming suitable for saw logs when they become large enough.

2/ Includes a small amount of soft maple and other soft hardwoods.

3/ Includes a small amount of other hard hardwoods.

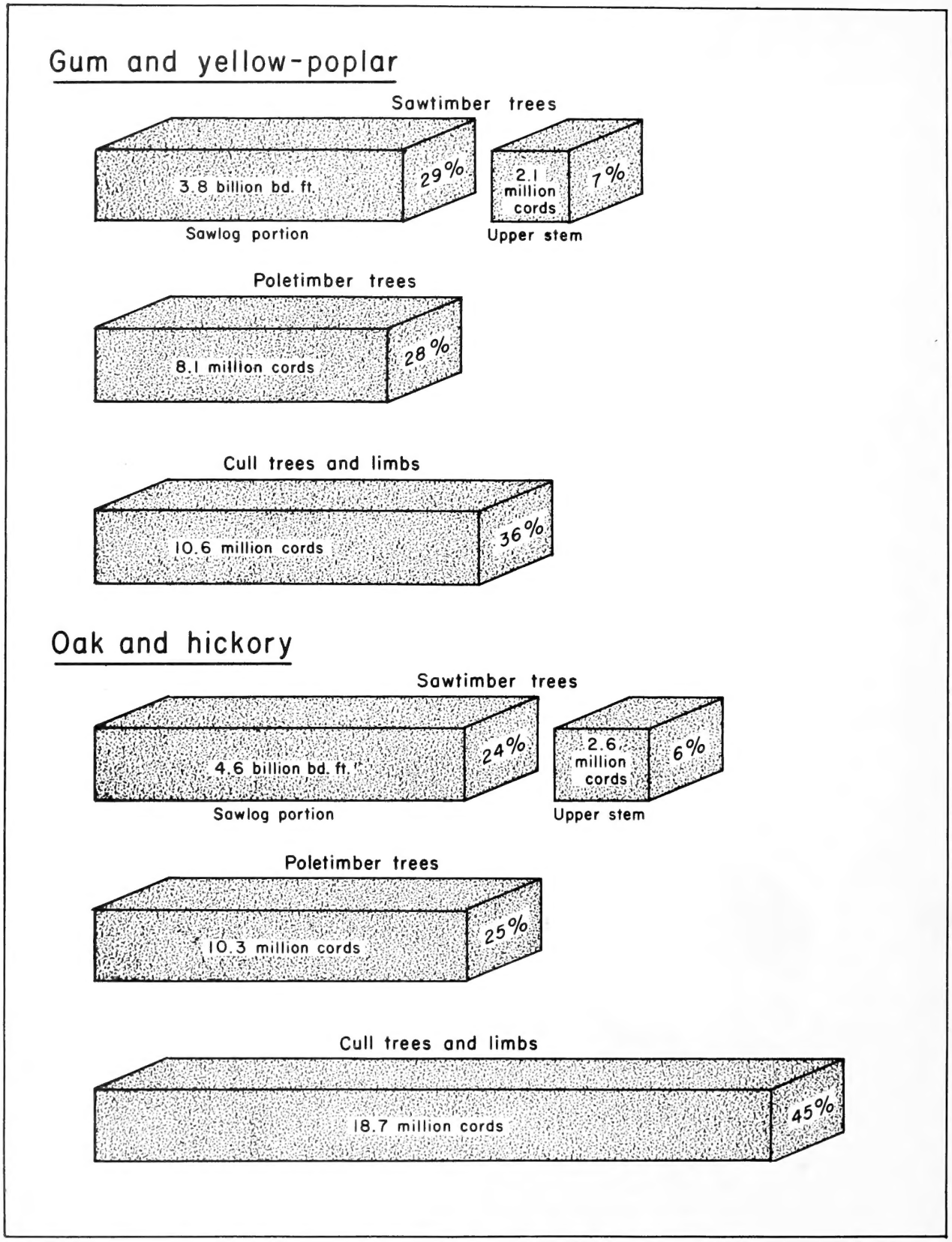


Figure 3.--Net volume of hardwood timber by species group and class of material.

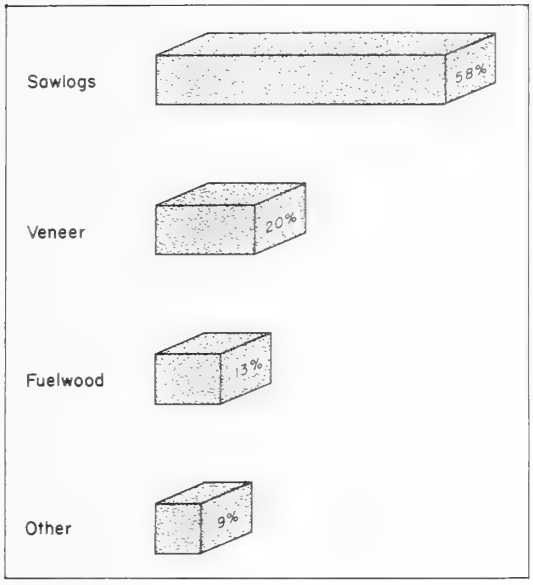


Figure 4.--Annual cut of hardwood growing stock by product.

Eighty-five percent of the annual hardwood cut comes from sawtimber trees. Sawmills and veneer plants use about four-fifths of the hardwood timber cut, and a fifth is used by veneer plants (fig. 4). Roughly, two-thirds of the hardwood lumber sawn is used for the manufacture of secondary products; the remainder is used for railroad ties and construction. The leading secondary products are containers, flooring, and furniture. By far the biggest share of the hardwood veneer is made into containers, including fruit and vegetable containers and packing cases. Less than 10 percent is used by furniture manufacturing plants. 4/

The relationship between standing hardwood sawtimber volume in central and north Georgia and wood used in manufacture in the entire state in 1948 provides some indication of the intensity of use by species. The ratio between wood used in manufacture and standing sawtimber is three times as great for gum and yellow-poplar as for oak and hickory. Yellow-poplar has the highest ratio, followed by ash, sweetgum, and blackgum. Yellow-poplar, which makes up 11 percent of the hardwood sawtimber volume, provided a fourth of the hardwood used in manufacture. Even soft maple, which is one of Georgia's least desirable species, showed a heavier use in relation to the supply than the oaks. The least used species in relation to the supply is hickory.

The heaviest demand is for large sawtimber, or trees 15.0 inches and larger, especially the large gum and yellow-poplar trees (fig. 5). About half the sawtimber volume is in large sawtimber trees, and 41 percent of this in gum and yellow-poplar. In contrast, three-fourths of the annual hardwood sawtimber cut comes from large sawtimber, two-thirds of this from gum and yellow-poplar.

In addition to the sawtimber, there are 18 million cords in hardwood trees 5.0 to 11.0 inches (poletimber) which are expected to qualify as sawtimber when they become large enough.

The relationship between current annual cut and growth is shown in figure 6 for the two species groups, gum and yellow-poplar, and oak and hickory.

4/ Wood used in manufacture, 1948, U. S. Dept. Agr. Forest Resource Rpt. No. 2, 66 pp., illus. 1951.

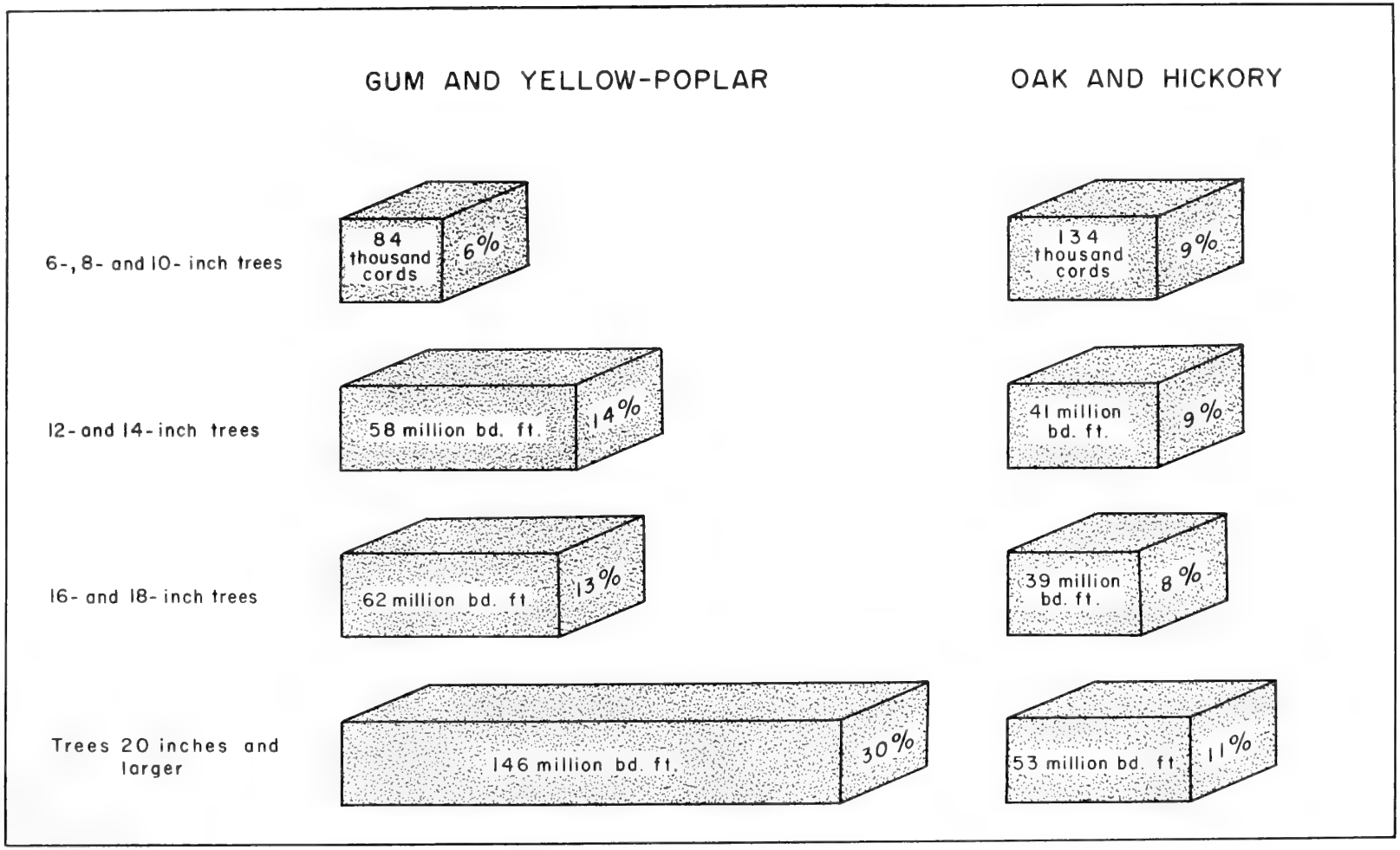


Figure 5.--Volume of hardwood growing stock cut annually, by size and species group. Forty-one percent of the hardwood timber cut comes from trees 20 inches and larger.

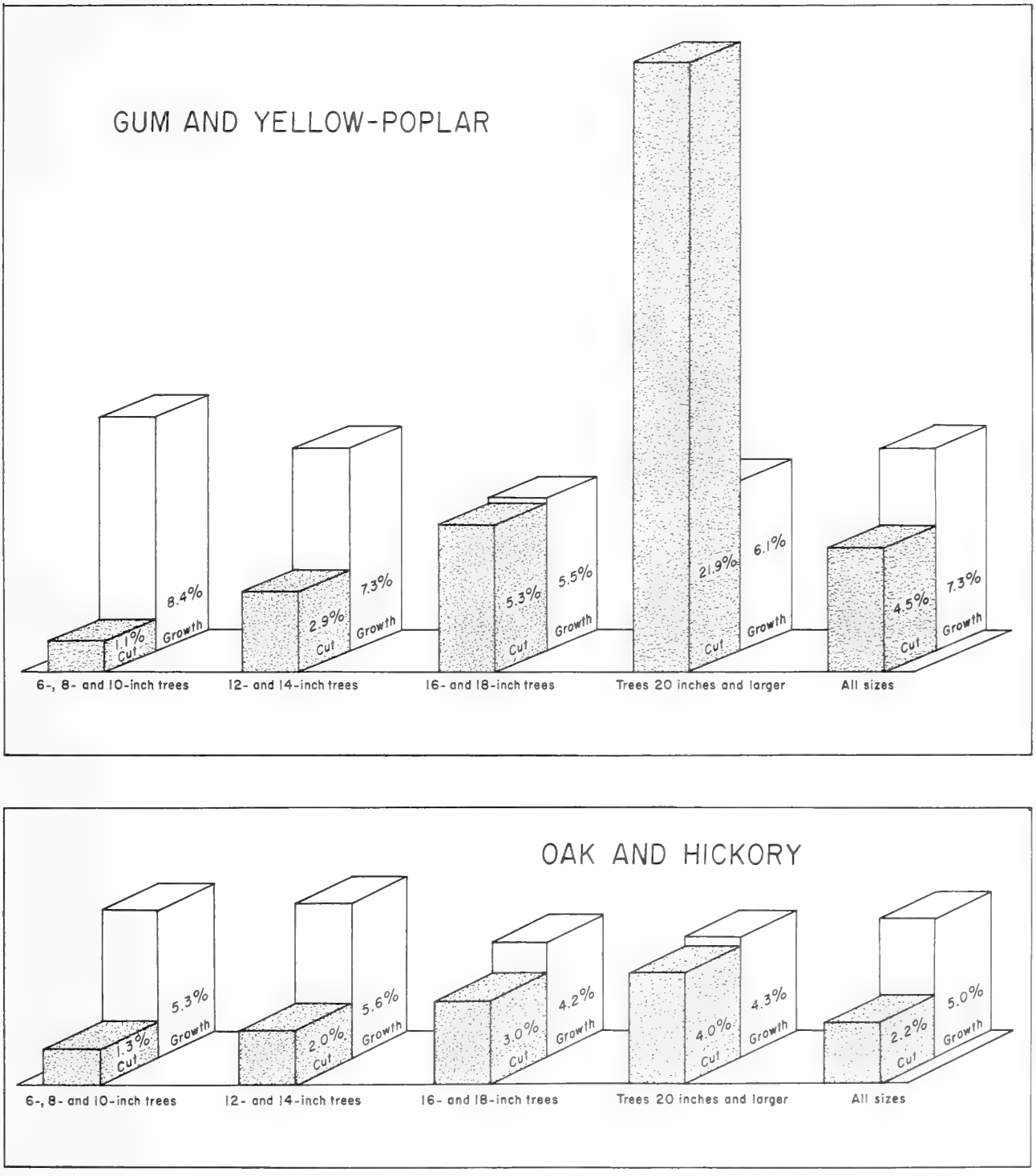


Figure 6.--Percent of growing stock cut annually and growth rate, by size of timber.

Volume in material not of growing stock quality amounts to 29 million cords--most of it in trees which, because of rot, crook, or excessive limbiness, will not qualify as sawtimber. Included is a small volume in limbs of sawtimber trees. Except for a small amount cut for fuelwood, practically no use is being made of this kind of timber.

In 1954, only 8,300 cords of hardwoods, excluding dead chestnut, were cut for pulpwood--less than one percent of the total pulpwood cut in Survey Units 3, 4, and 5. While this was an increase over the 5,000 cords cut in 1953, it was less than the 10,000 cords cut in 1952.

Hardwood cutting in relation to growth in most parts of central and north Georgia is light. At the time the Forest Survey was in progress, the cut of gum and yellow-poplar exceeded the average growth rate in only 26 out of the total 102 counties. Hardwoods were being cut heaviest in the areas bordering the principal rivers in the southern part of Survey Unit 3. An especially heavy cut of gum and yellow-poplar was under way in the upper reaches of the Flint River in the west central part of the State (fig. 7).

Oak and hickory were being cut the heaviest in the northern part of the State, but in only a few counties was the cut in excess of growth.

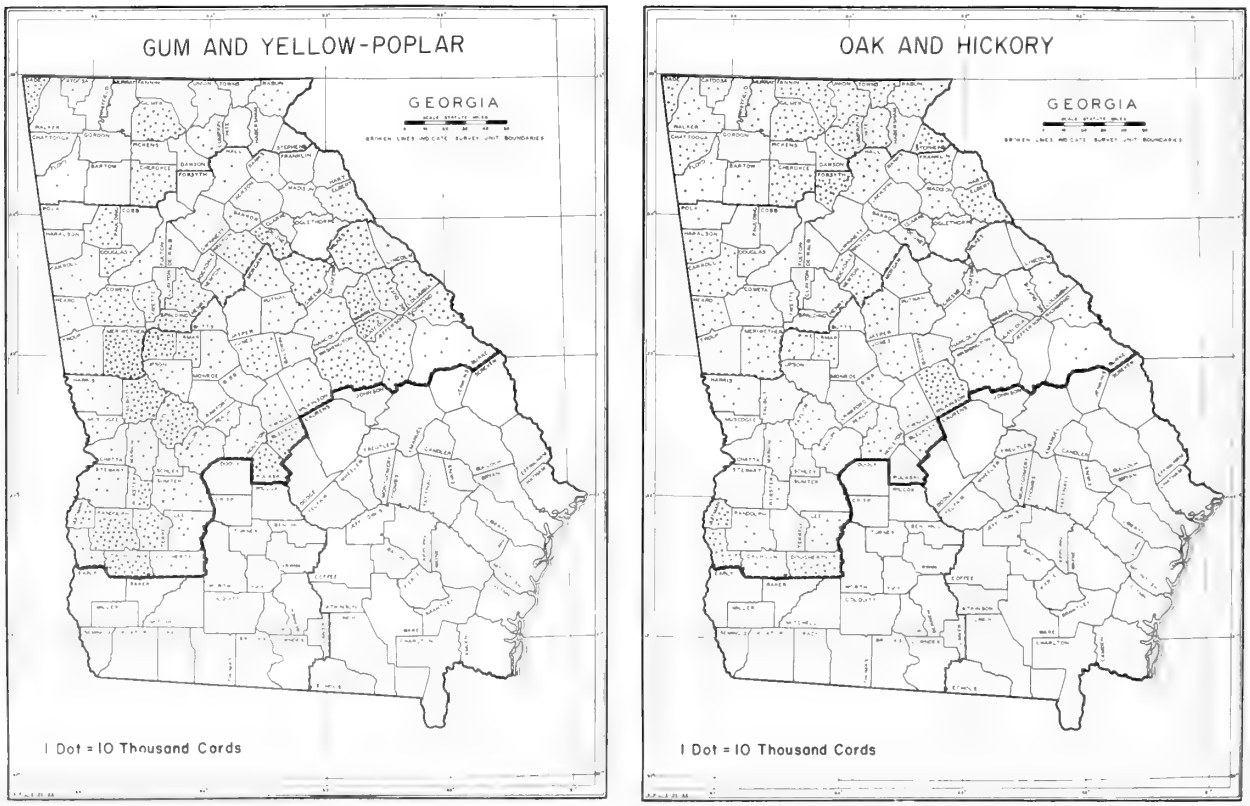


Figure 7.--Average annual volume of hardwood growing stock cut by county.

TREND IN THE HARDWOOD TIMBER SUPPLY

In the 18 years between surveys in central and north Georgia, the volume of hardwood growing stock, i.e., volume in sound trees 5.0 inches and larger, increased by 3 percent. However, not all hardwoods of all sizes increased; the increase was due mainly to large increases in small timber, especially oak and hickory. Gum and yellow-poplar growing stock dropped 9 percent, while oak and hickory increased 15 percent. A drop of 24 percent in gum and yellow-poplar sawtimber resulted in a 10-percent decrease in all hardwood sawtimber in spite of the 6-percent increase in oak and hickory sawtimber.

Large gum and yellow-poplar timber has borne the brunt of the cutting between surveys. The volume in 16- and 18-inch gum and yellow-poplar trees decreased 27 percent, and the volume in trees 20 inches and larger dropped nearly 60 percent. In recent years, growth of the 16- and 18-inch trees has overtaken the cut, but the volume in trees 20 inches and larger is dropping even faster now than during the past 18 years (fig. 8). The current annual cut of this larger timber is 22 percent of the growing stock--more than three times the growth.

Between surveys, growth of 16- and 18-inch oak and hickory was just about enough to replace the cut (fig. 9). The volume in 20-inch and larger oak and hickory declined, but not nearly as much as gum and yellow-poplar.

The volume of hardwood poletimber increased by about one-fourth between the two surveys. The increase in small gum and yellow-poplar sawtimber was considerably less, but that of small oak and hickory sawtimber was almost as great as poletimber. At present, both poletimber and small sawtimber, all hardwood species, are increasing at an even faster rate than in the past, as shown in figures 8 and 9.

There is two-thirds again as much volume in cull trees now as there was at the time of the first survey. All the increase was in sound cull timber, especially gum and yellow-poplar. The volume in rotten culls actually declined. There is now three and a half times as much volume in gum and yellow-poplar culls 16 inches and larger as in 1936. Assuming that sound cull trees are growing at approximately the same rate as the growing stock, the volume in sound cull trees is increasing at the rate of about 4 percent a year. The trend in the general quality of hardwood timber is down. In 1936, 16 percent of the gum and yellow-poplar volume was in cull trees; by 1953, the proportion has increased to 29 percent. The proportion of oak and hickory volume in cull trees increased from 31 to 37 percent during this time.

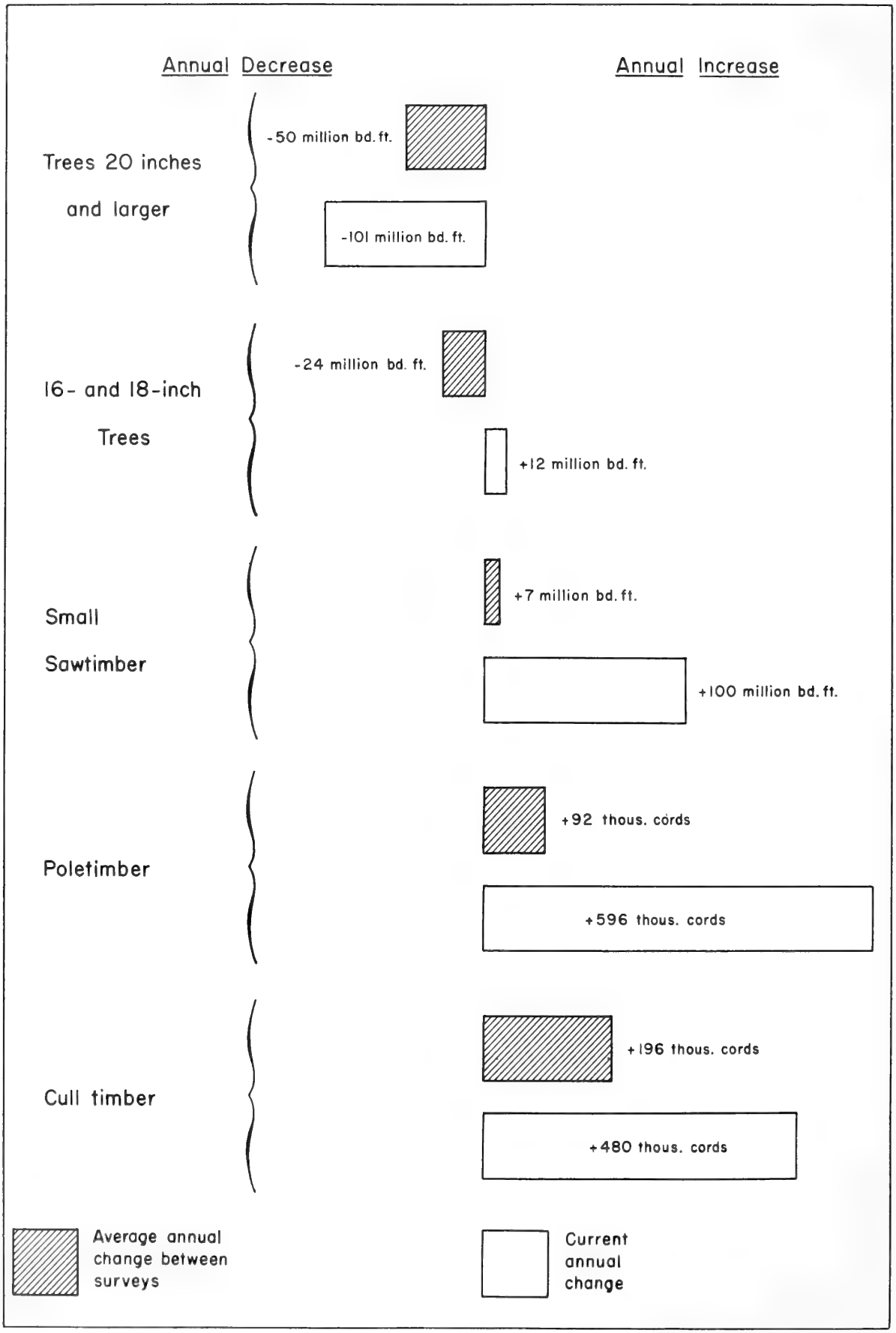


Figure 8.--Change in volume of gum and yellow-poplar.

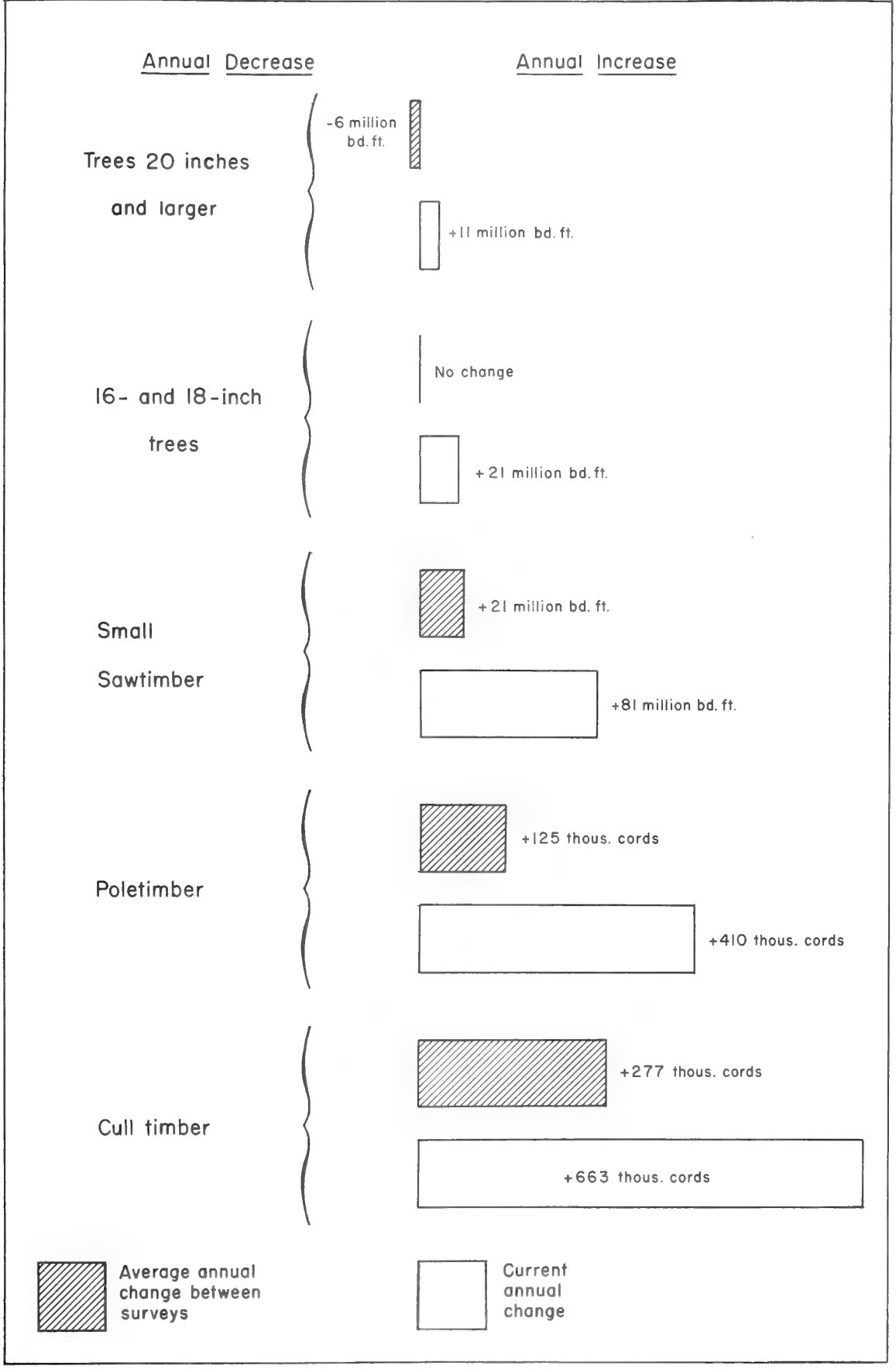


Figure 9.--Change in volume of oak and hickory.

GEOGRAPHIC DISTRIBUTION OF HARDWOODS

Figures 10 through 12 show distribution of total net cubic foot volume of the principal hardwood species, including net volume in cull trees, by county. Figure 13 shows the distribution of large and small sawtimber volume for the two principal groups of hardwood species, and figure 14 shows the distribution of hardwood pole timber and cull timber volume for the two hardwood species groups.

The southern part of the region, especially the river bottoms bordering the major streams, contains most of the gum volume. The largest share of oak volume, on the other hand, is concentrated in the northern part of the State, especially in the mountains. The other principal hardwood species, including yellow-poplar, soft maple, and hickory, are distributed fairly evenly throughout the State.

Distribution of hardwoods by size of timber follows much the same general pattern except that the smaller timber appears to be more evenly distributed than large timber. Thus, areas deficient in small sawtimber or poletimber are not as evident as areas deficient in large sawtimber.

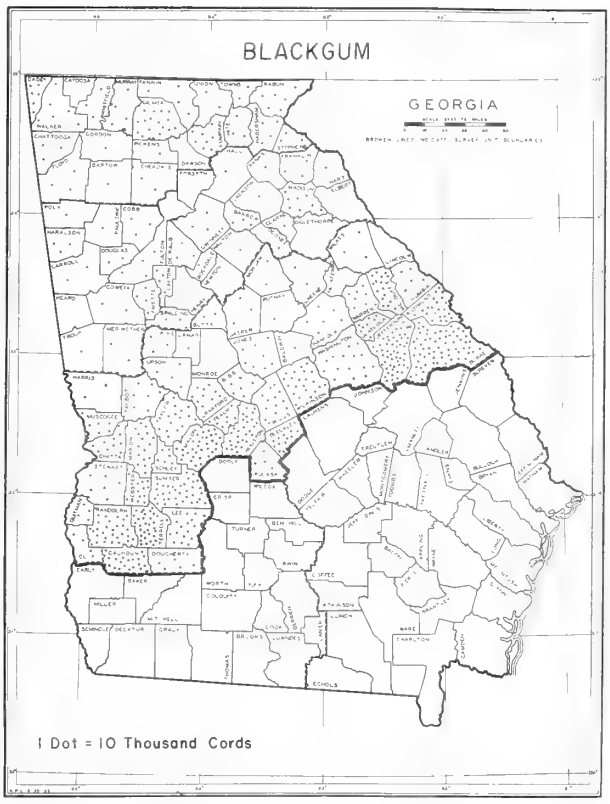
About 40 percent of the total hardwood volume is in cull trees. Cull timber averages 4.6 cords per acre of hardwood type; however, in individual counties the volume of cull per acre goes as high as 16 cords. Several counties in the northern section have more than 10 cords of cull per acre. The quality of the timber is especially low in the northwestern ridge and valley section. Here a large group of counties have more than 50 percent of the total volume in cull trees. In the central and southwestern parts of Unit 3, the quality of the hardwood timber is better than average. A number of counties in these sections have less than a third of the total hardwood volume in cull trees.

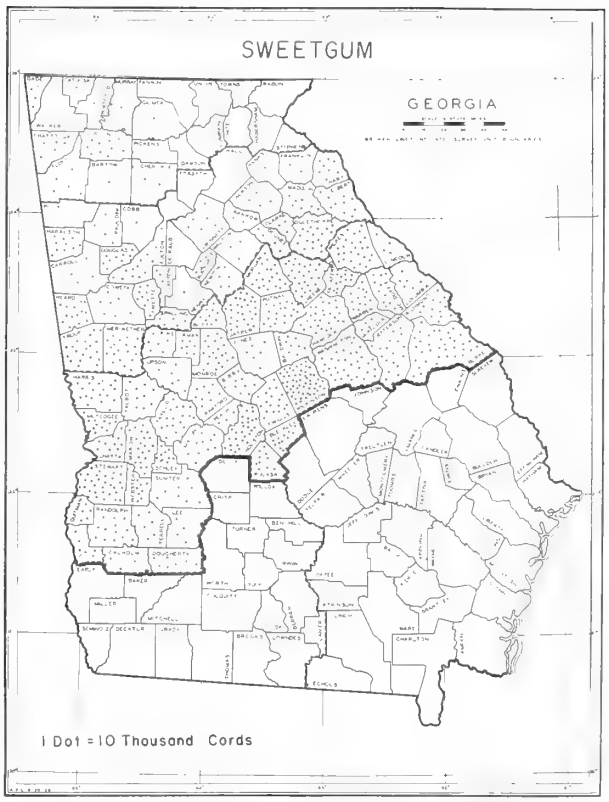
A large share of the cull volume, practically all of it oak and hickory, is concentrated in the northern section. Elsewhere, cull volume of hardwoods is fairly evenly distributed.

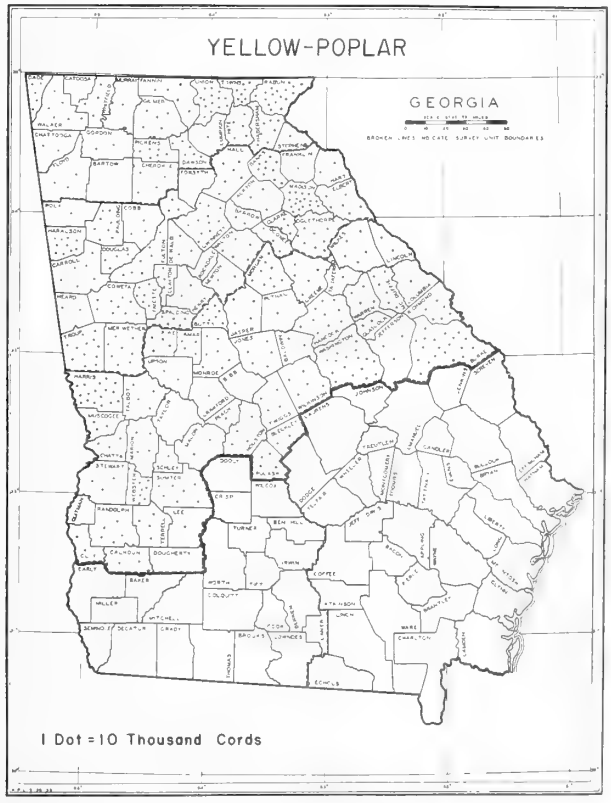
OUTLOOK FOR HARDWOOD MANAGEMENT

Land Suitable for Growing Hardwoods

A large share of the forest land is capable of growing good quality hardwoods. Nearly 90 percent of the forest land now supporting hardwood types, or 4 million acres, is capable of growing hardwoods with at least two 16-foot saw logs in them; over a third will grow hardwoods with three or more saw logs (table 2). Also, there are nearly 4 million acres of pine and oak-pine types on good sites capable of growing good-quality hardwoods. Some of these best sites are probably better suited to growing hardwoods than pine because of the difficulty of perpetuating the pine in face of the strong hardwood competition. Growing good-quality hardwoods in mixture with the pine may prove to be the most profitable system of management on a large part of this land. Altogether, it is estimated that about 8 million acres out of the 13 million acres of the forest area in central and north Georgia are capable of growing good-quality hardwoods.







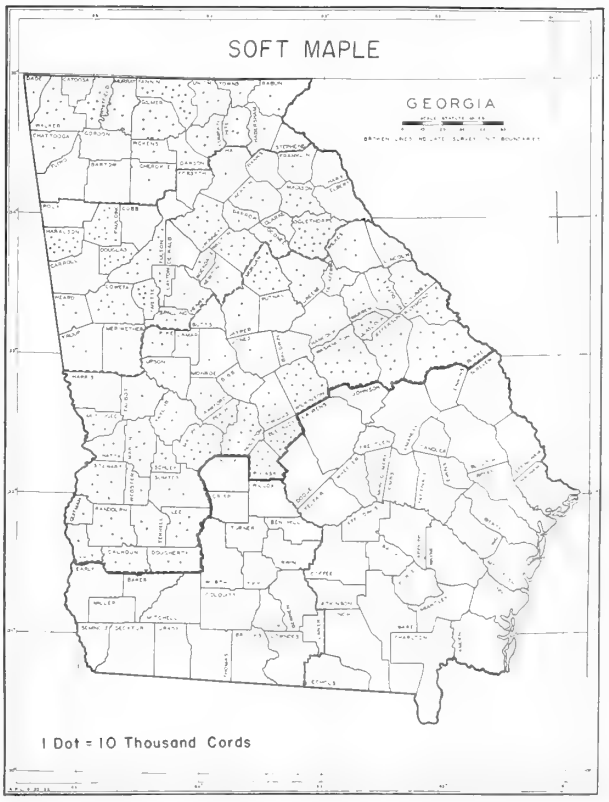


Figure 10.--Distribution of gum, yellow-poplar and soft maple timber.

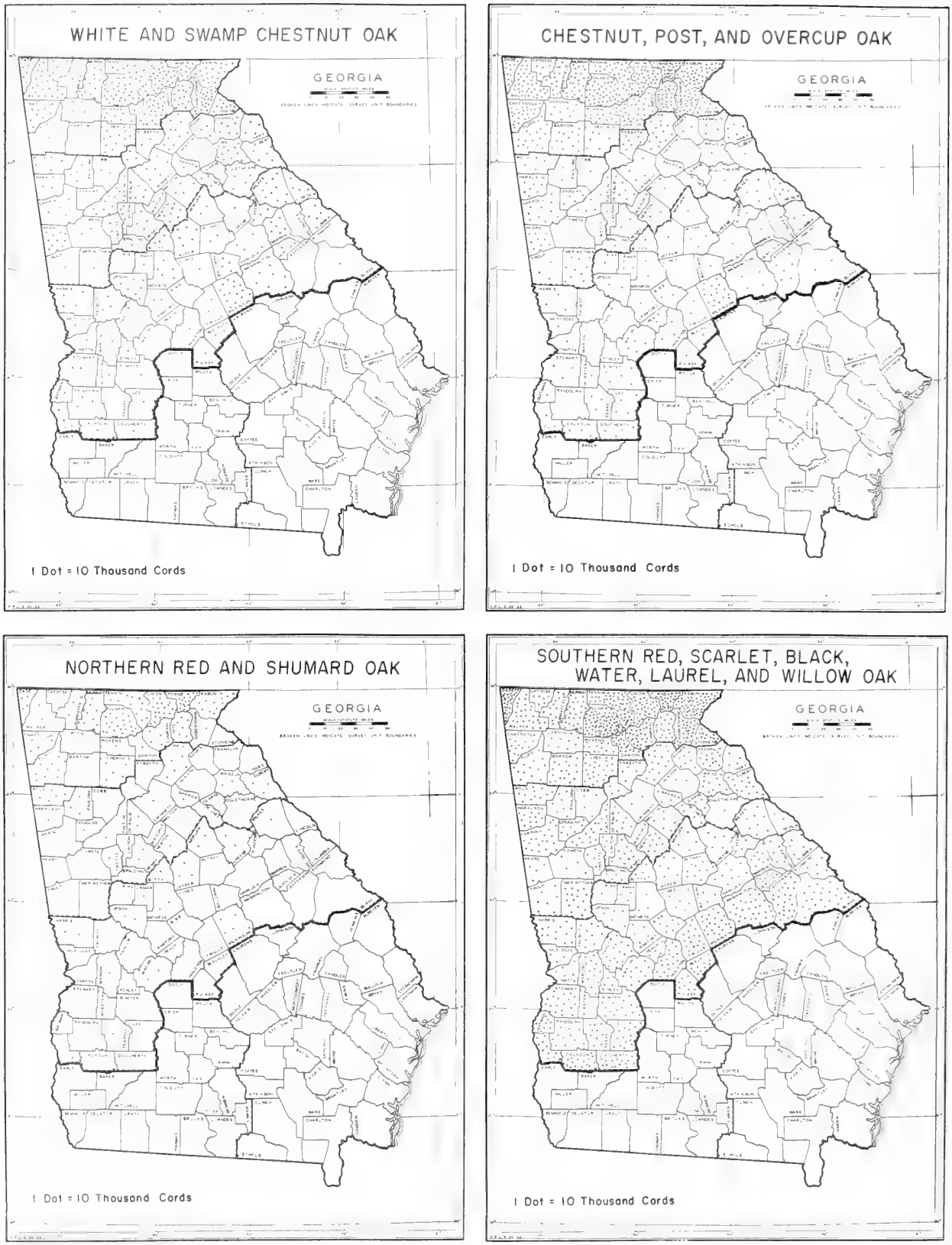


Figure 11.--Distribution of oak timber.

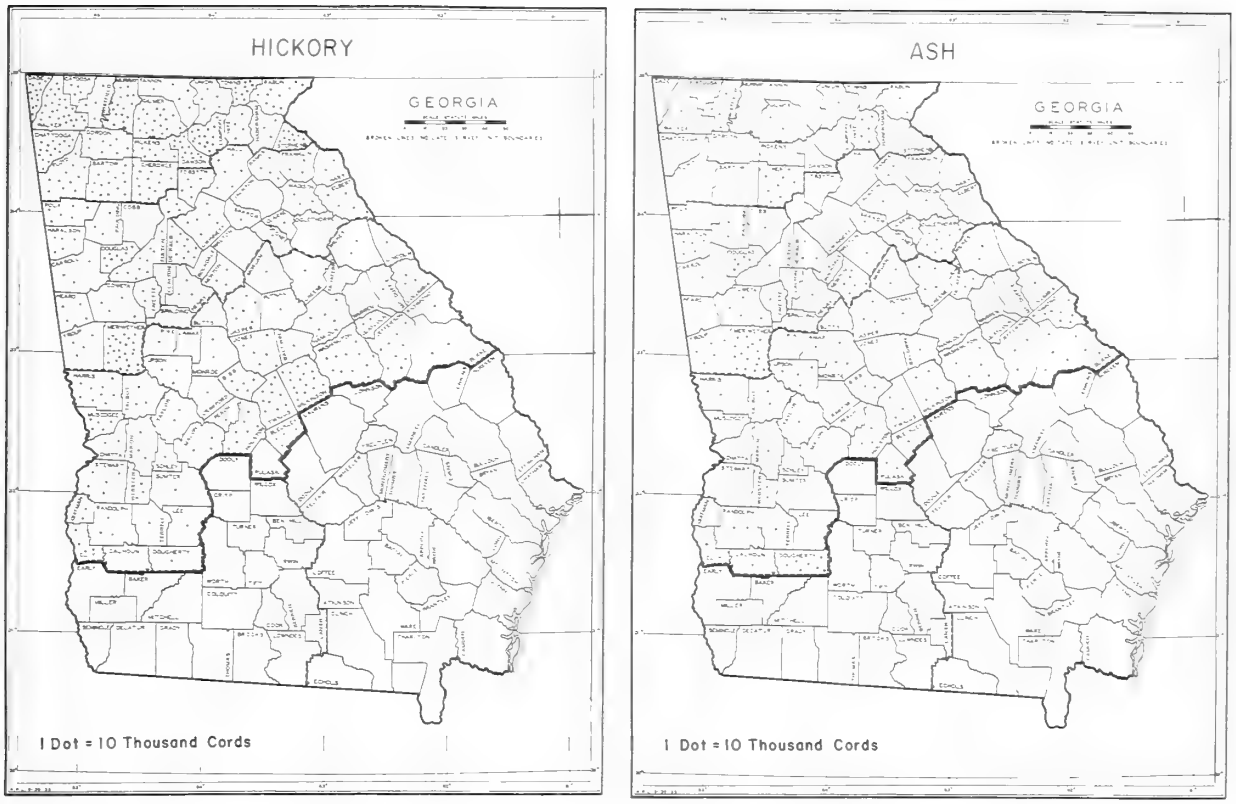


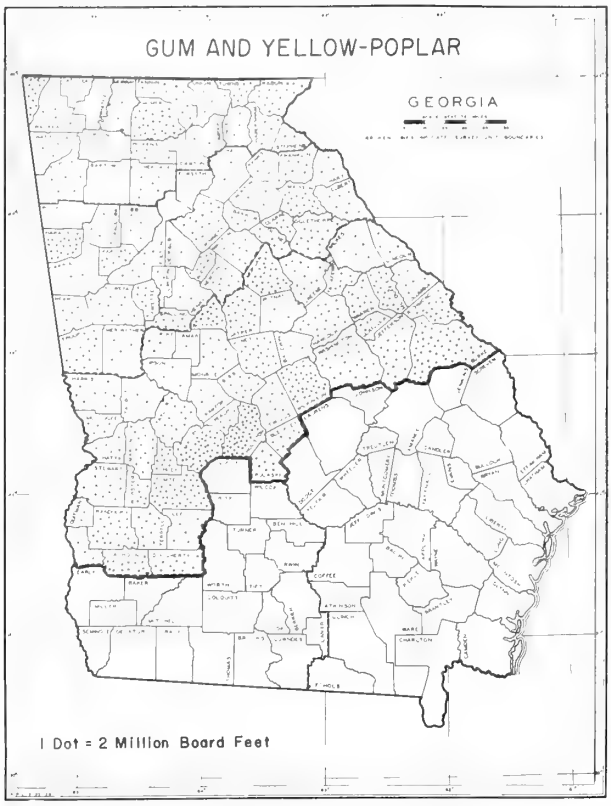
Figure 12.--Distribution of hickory and ash timber.

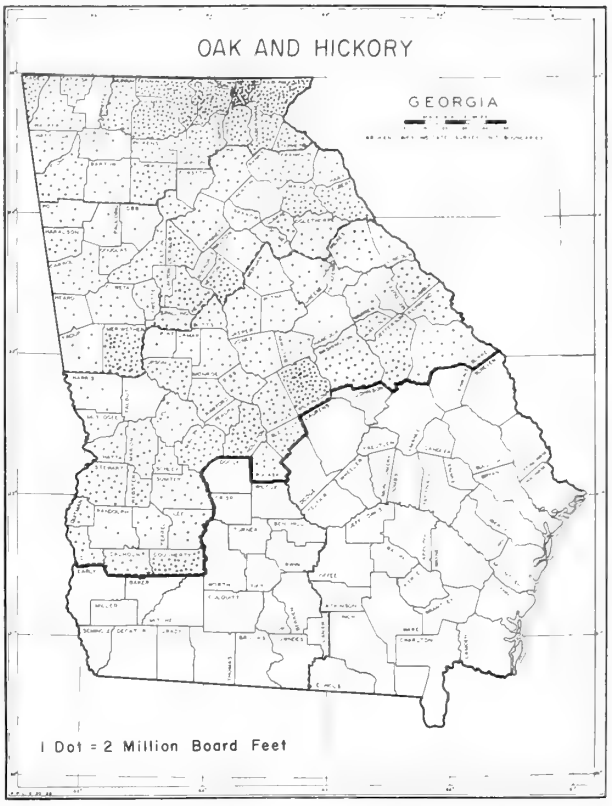
Table 2.--Area of forest types by site quality [1/]

Forest type	Site quality			
	Poor	Fair	Good	Total
	Thousand acres			
Pine	1,428	2,539	3,031	6,998
Oak-pine	399	514	667	1,580
Oak-hickory	317	1,488	759	2,564
Oak-gum-cypress	90	900	924	1,914
Scrub oak	221	8	- -	229
Total	2,455	5,449	5,381	13,285
Percent	18.5	41.0	40.5	100.0

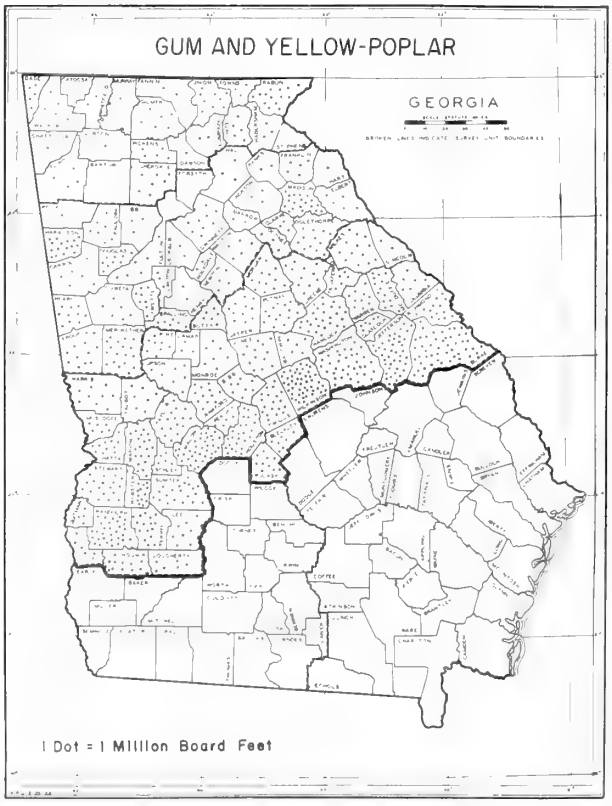
1/ Site quality of pine and oak-pine types is based on the total height of pine at age 50. For loblolly pine and oak-loblolly pine types, an index of 60 or shorter is regarded as poor site, 70 fair site, and 80 and taller good site. For other pine and oak-pine types, a site index of 50 or shorter is considered poor site, 60 fair site, and 70 and taller good site. Site quality of hardwood types is based upon the number of 16-foot saw logs in hardwood trees at maturity. Sites capable of growing hardwoods with three or more saw logs are considered good sites, 2 logs fair sites, and 1 log and less poor sites.

LARGE SAWTIMBER





SMALL SAWTIMBER



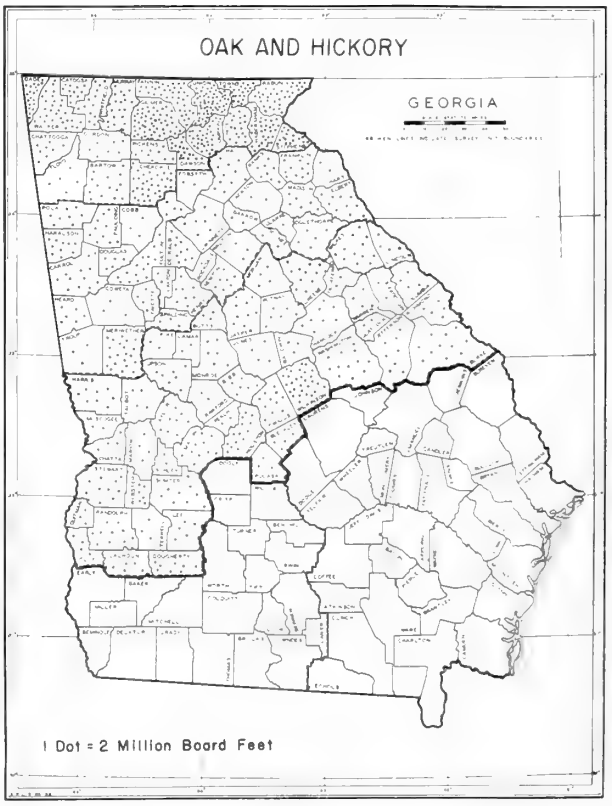
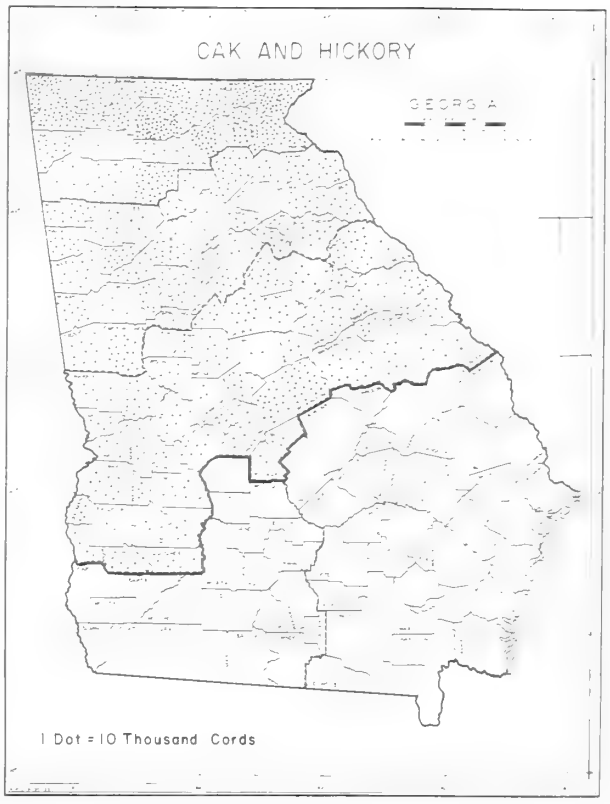


Figure 13.--Distribution of hardwood sawtimber by county.

POLETIMBER



CULL TIMBER

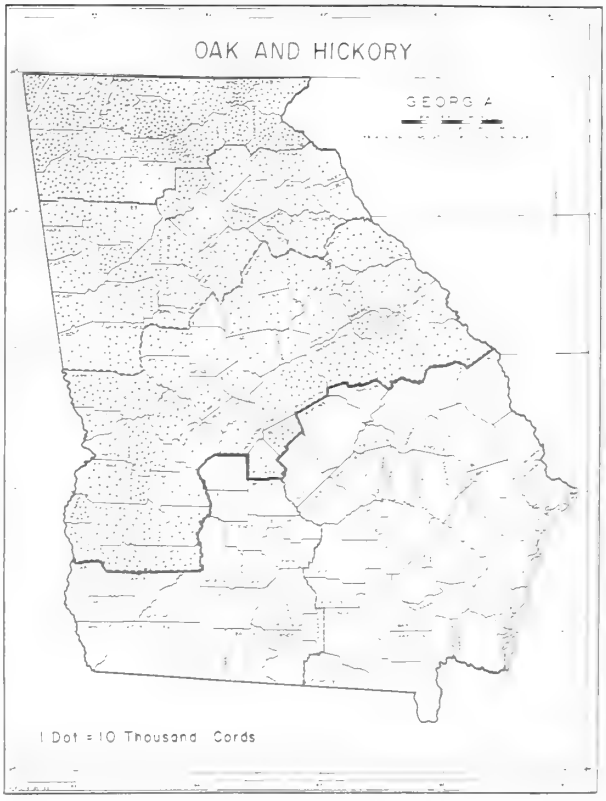


Figure 14.--Distribution of hardwood poletimber and cull timber by county.

In addition, there are about 3 million acres of pine and oak-pine types on fair sites. Some of this area may be capable of growing fair to good-quality hardwoods. Research is needed to determine the hardwood growing potential of these fair pine and oak-pine sites.

Only 2.5 million acres, or 18 percent of the forest area, is clearly unsuited to the production of good-quality hardwoods. This includes 628,000 acres of hardwood type on poor sites. On these areas hardwood trees are short and excessively limby. They seldom contain more than one merchantable saw log, and many never do contain enough merchantable material to qualify as sawtimber. The principal species on 221,000 acres of this poor site area is scrub oak. This land, consisting mainly of deep, coarse sand, once grew longleaf pine, but repeated burning and cutting have eliminated the pine and left only the scrub oak and other low-quality hardwoods.

Equally unsuited to hardwood production are the 1.8 million acres in pine and oak-pine types on poor sites.

Hardwood types on good and fair sites are distributed evenly throughout the region (fig. 15). Hardwood types on poor sites are especially concentrated in the scrub oak of the western Sandhills (fig. 2). The distribution of oak-pine type is about the same on all sites.

Available Growing Stock

While most of the hardwood stands have more than enough trees in them to fully utilize the available growing space, a great many contribute little or nothing to the productivity of the stand. Only about half the hardwood stands have enough trees of growing stock quality, counting seedlings, to fully stock them (table 3). Another 16 percent is well stocked, that is, 70 to 99 percent stocked. Only 53 percent of the total number of hardwood trees 1.0 inch and larger is of growing stock quality (table 4).

Table 3.--Stocking of growing stock on commercial forest land by forest type

Forest type	Stocking class					Total
	0-9	10-39	40-69	70-99	100+	
	Percent					
Oak-pine	3	14	12	14	57	100
Oak-hickory	8	12	18	15	47	100
Oak-gum-cypress	3	13	16	17	51	100
Hardwood types	6	12	17	16	49	100
Pine	4	15	14	12	55	100
All types	5	14	15	14	52	100

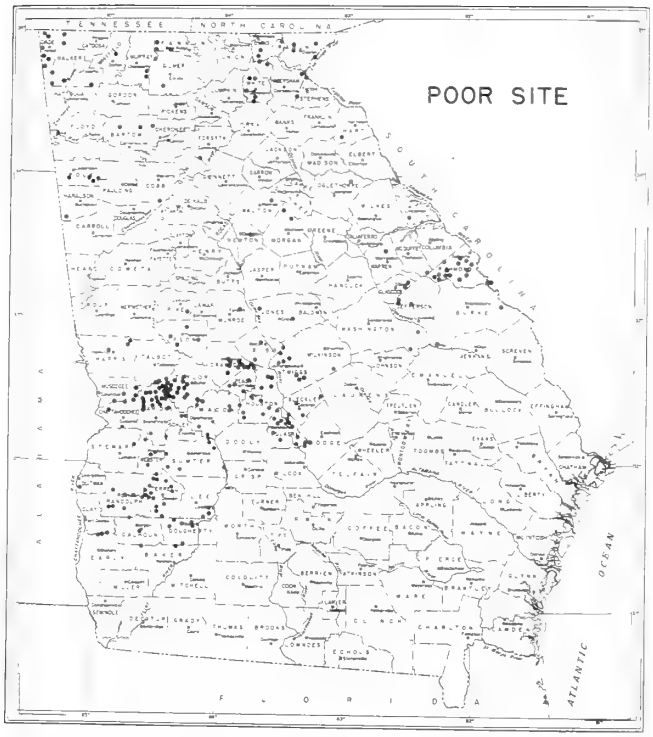


Figure 15.--Distribution of hardwood type forest survey plots by site quality.

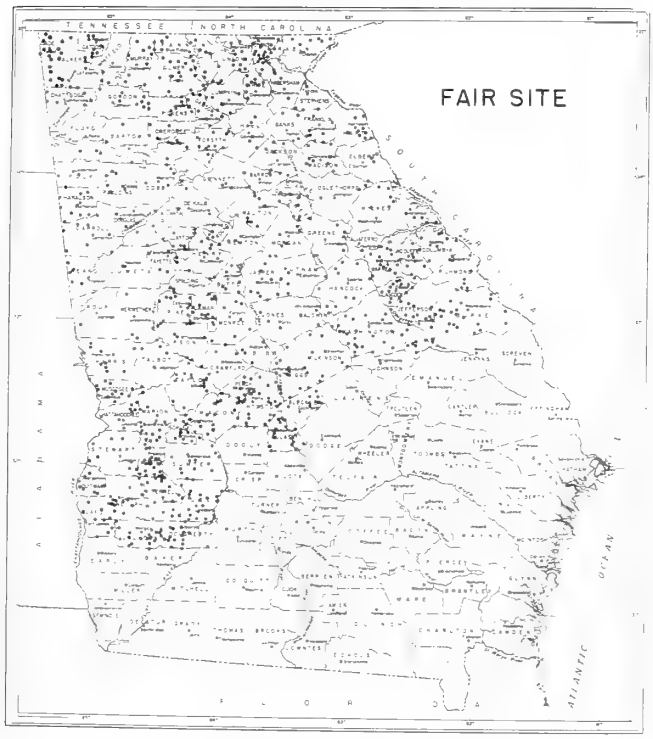


Table 4.--Proportion of the total number of hardwood trees by quality class

Tree quality	Saplings	Poles	Small sawtimber	Large sawtimber	All sizes
			Percent		
Gum and yellow-poplar:					
Growing stock	62	63	71	63	62
Sound culls	37	34	24	26	37
Rotten culls	1	3	5	11	1
All	100	100	100	100	100
Oak and hickory:					
Growing stock	48	49	61	58	48
Sound culls	51	49	35	32	51
Rotten culls	1	2	4	10	1
All	100	100	100	100	100
All hardwoods:					
Growing stock	52	54	65	59	53
Sound culls	47	43	31	30	46
Rotten culls	1	3	4	11	1
All	100	100	100	100	100

Site quality has a profound effect on stocking. Good sites have roughly twice as much basal area of growing stock as poor sites (table 5). Also, the better the site, the larger the proportion of hardwood trees that qualify as growing stock (table 6).

Moreover, the better the site quality, the more closely the distribution of the trees by size class approaches the desirable distribution [5/] on well managed forests. For the most part, the stands are adequately stocked with 2- and 4-inch sound trees. Poor sites are extremely deficient in all trees above 4 inches and have practically no trees above 16 inches on them (figures 16 and 17).

5/ Based on de Liocourt's "q" value of 1.50. This is the ratio in number of trees between size classes. Present pine stands in Georgia have a "q" value of about 2.2; hardwood stands 1.8. Managed selection forests in Switzerland and virgin selection forests in this country have a "q" value of about 1.3.

Table 5.--Average basal area of growing stock by site and type

Forest type	Site quality	Basal area	Percent of full stocking
		Square feet	Percent
Loblolly pine	Poor	26	38
	Fair	32	47
	Good	49	72
Shortleaf pine	Poor	31	46
	Fair	33	49
	Good	50	74
Oak-loblolly pine	Poor	24	35
	Fair	29	43
	Good	58	86
Oak-shortleaf pine	Poor	28	41
	Fair	38	56
	Good	46	68
Oak-hickory	Poor	23	34
	Fair	33	49
	Good	47	69
Oak-gum-cypress	Poor	14	21
	Fair	36	53
	Good	60	89

The size-class distribution in hardwood stands is much more favorable than in oak-pine stands, especially on the better sites. The distribution of basal area by size class on good oak-gum-cypress sites, for example, very closely approaches the desirable.

Growing Stock Quality

Down through the years, loggers have continually removed the more desirable trees from the stands, leaving the less desirable species and individuals. Figure 18 shows the proportion of the total net volume in cull trees for the principal hardwood species and species groups. "Other hard hardwoods" includes the volume of scrub oak.

Table 6.--Basal area per acre of hardwood growing stock and all hardwood 1.0 inch and larger by type and site quality

Forest type	Site quality	Growing stock	All trees	Growing stock
		Sq. ft.	Sq. ft.	Percent
Loblolly pine	Poor	3.78	8.39	45
	Fair	5.30	9.93	53
	Good	9.25	15.19	61
	All sites	6.78	11.78	58
Shortleaf pine	Poor	7.10	16.62	43
	Fair	4.53	11.50	39
	Good	9.87	18.01	55
	All sites	7.37	15.36	48
Oak-loblolly pine	Poor	15.51	29.23	53
	Fair	18.13	32.70	55
	Good	25.22	41.46	61
	All sites	21.30	36.58	58
Oak-shortleaf pine	Poor	18.34	36.37	50
	Fair	24.24	39.92	61
	Good	29.55	44.82	66
	All sites	24.42	40.64	60
Oak-hickory	Poor	18.06	45.00	40
	Fair	30.19	53.94	56
	Good	44.58	71.94	62
	All sites	32.89	58.21	57
Oak-gum-cypress	Poor	11.54	30.88	37
	Fair	33.09	57.80	57
	Good	57.96	85.99	67
	All sites	43.90	69.89	63

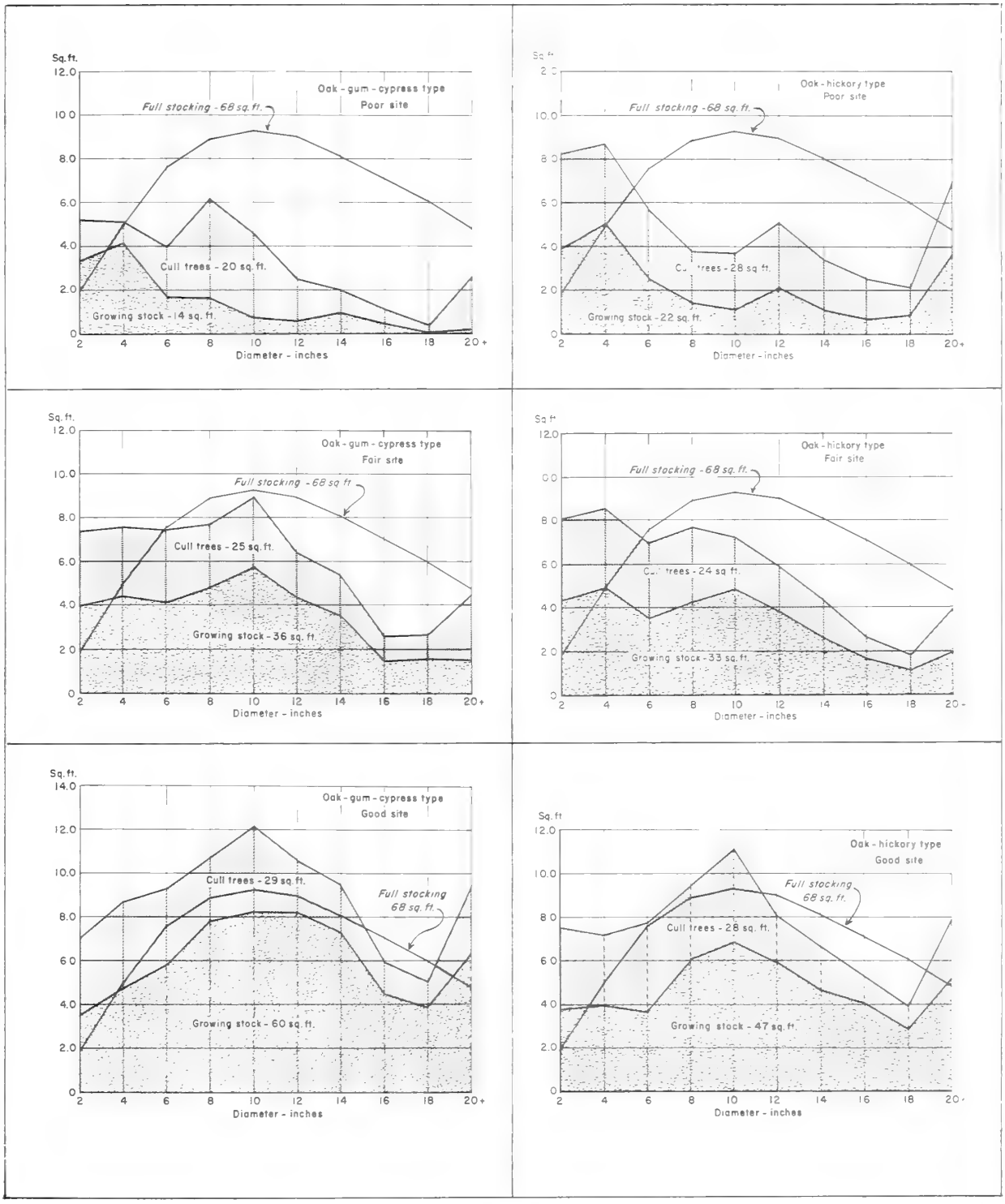


Figure 16.--Basal area per acre of trees in oak-hickory and oak-gum-cypress types, by tree quality, size, and site quality.

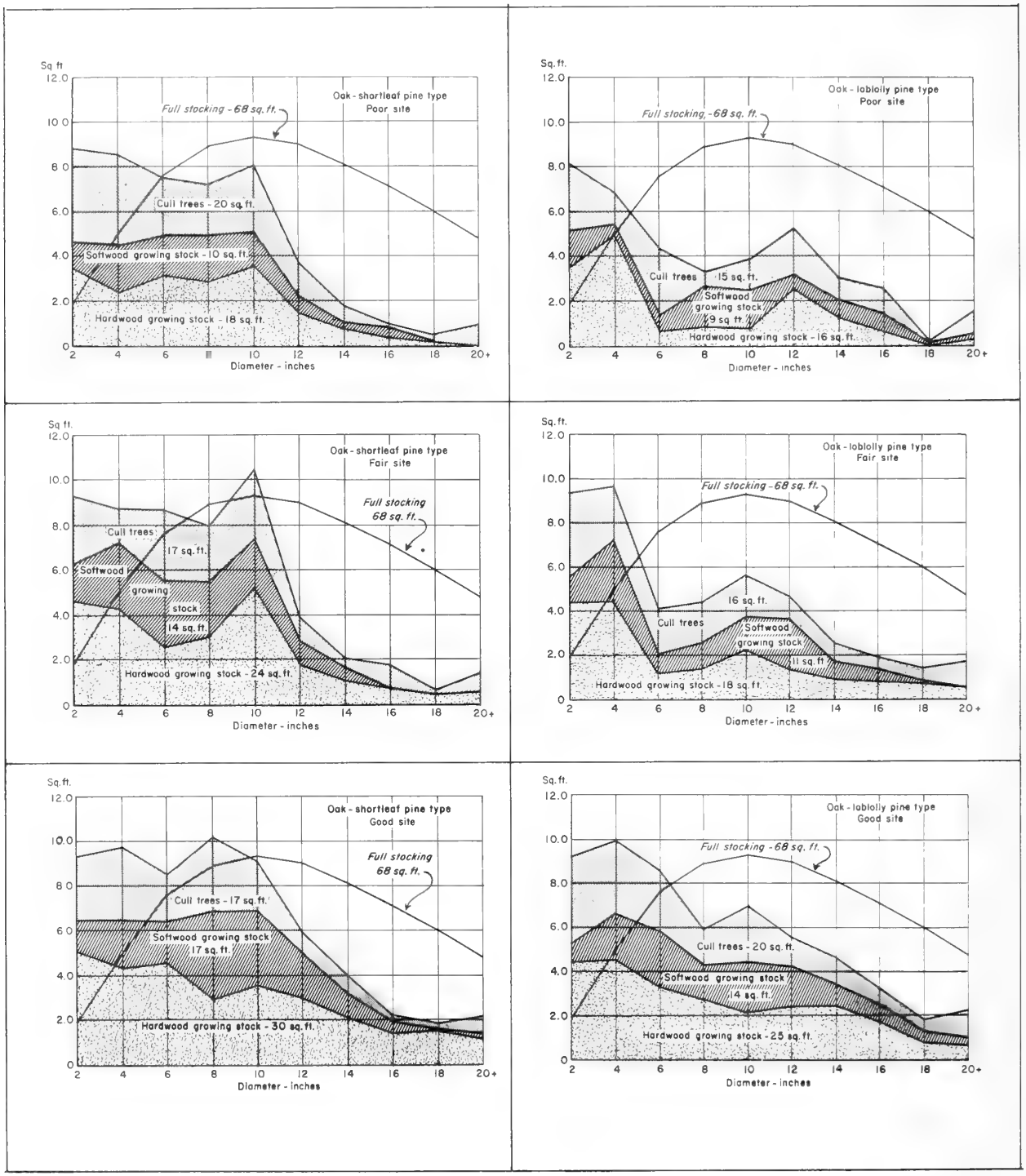


Figure 17.--Basal area per acre of trees in oak-shortleaf pine and oak-loblolly pine types, by tree quality, size, and site quality.

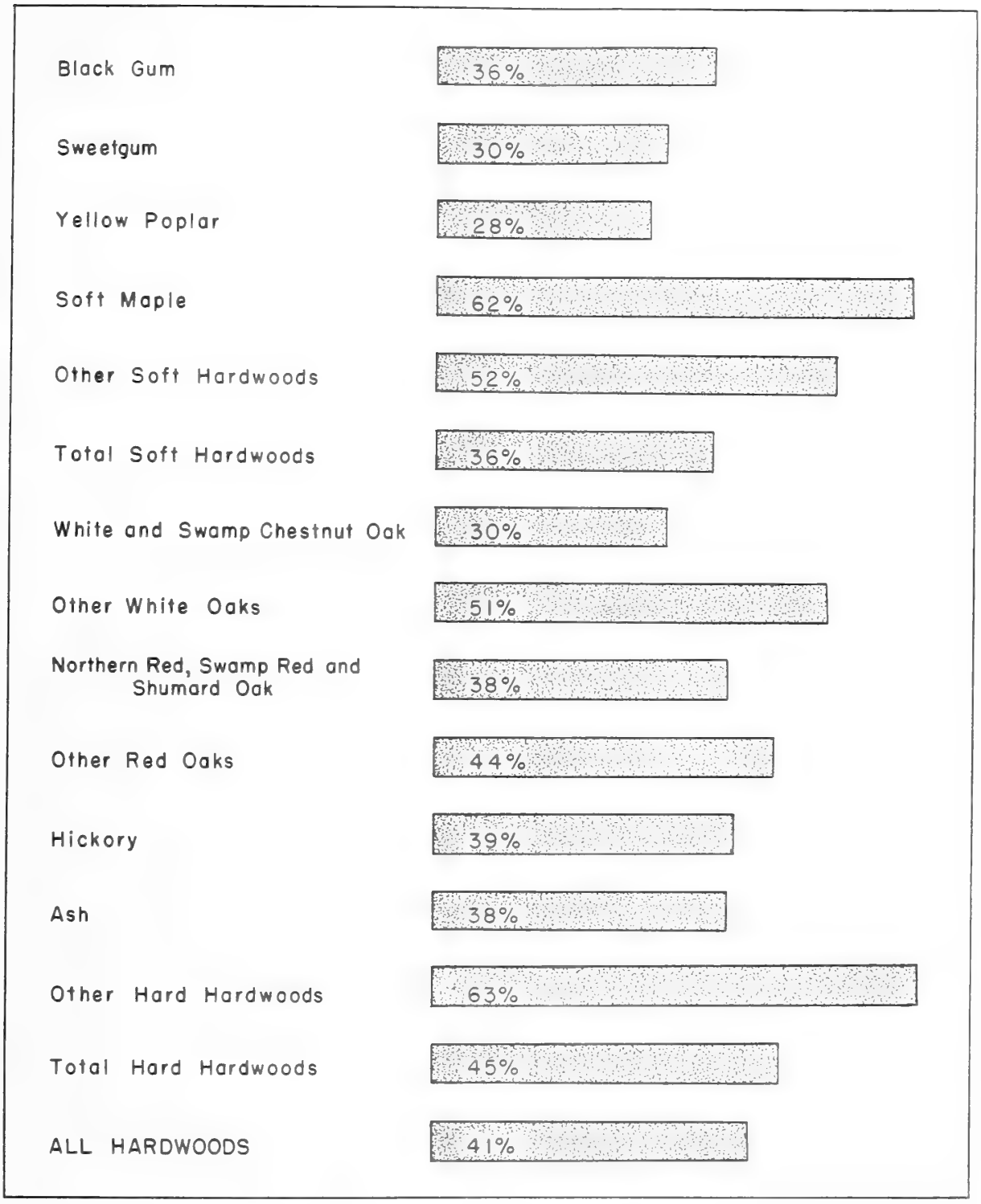


Figure 18.--Percent of the total net hardwood volume in cull trees, by species.

The present growing stock trees are shorter, more defective, and contain fewer high-grade logs than landowners could expect to produce under good forest management. Gum and yellow-poplar large sawtimber have on the average between two and two-and-a-half merchantable saw logs in them; the oaks and hickory are about a half a log shorter (table 7). Between 12 and 15 percent of the board-foot volume in sawtimber is unusable for lumber because of defects (table 8). Log grade quality varies a good deal by species (table 9). The proportion of the volume in grade 1 and 2 logs for large sawtimber ranges from a third or less for such species as soft maple, hickory, and other red oaks to about a half for blackgum, white, and swamp chestnut oak, and ash.

Frequency of Occurrence by Species

A knowledge of the natural tendency for various species to grow in certain combinations and on certain sites provides the landowner with valuable guides to increasing the proportion of the more desirable species in the stand. In the present stands, the frequency and intensity of past cutting, the kind of timber cut, the frequency and intensity of past fires, whether or not the land was cleared for agriculture, the time since the land reverted from farm to forest, and probably other factors have all played a part in determining the occurrence and abundance of the various species. Forests which have not been subjected to major disturbing influences are practically nonexistent in this section of Georgia. Thus, a knowledge of the species composition pattern in these disturbed stands may be even more valuable to the landowner than in natural undisturbed stands.

In the first place, managed stands are disturbed stands; in place of unplanned disturbances, the forest manager merely substitutes carefully controlled disturbances designed to produce a desired effect--such as increasing the amount of pine or yellow-poplar in the stands. Also, it is these disturbed stands that landowners must begin with in improving their forests. The species represented and their abundance in the understory of the present stands on certain sites may provide an important clue as to what individual species should be favored on these sites. Detailed information on the occurrence and abundance of the important hardwood species by forest type, site quality, and size of timber is presented in the charts that follow.

Figures 19 through 22 show the proportion of hardwoods, including cull trees, in the pine and oak-pine stands by diameter class. In general, they show that proportion of hardwoods is greatest among the smallest and largest tree sizes. Figures 23 through 32 show the relative frequency of principal hardwood species by diameter class in stands on various sites.

Table 7.--Average merchantable height by species and size of timber

Species	Pole-timber 1/	Small sawtimber 2/	Large sawtimber 2/
	Feet		
Blackgum	30	29	36
Yellow-poplar	30	32	40
Sweetgum	23	28	37
Soft maple	23	22	26
Other soft hardwoods	24	30	32
White & swamp chestnut oak	24	23	27
Other white oaks	24	21	26
Northern red, swamp red, & shumard oak	24	25	29
Other red oaks	23	25	29
Hickory	24	23	29
Ash	30	23	37
Other hard hardwoods	21	23	27

1/ Height to a 4-inch top inside bark.
2/ Height to the top of the last merchantable saw log.

Table 8.--Average cull percent of large and small sawtimber by species

Species	Small sawtimber	Large sawtimber
	Percent	
Black and tupelo gum	15	13
Yellow-poplar	11	12
Sweetgum	14	12
Soft maple	11	15
Other soft hardwoods	18	12
White & swamp chestnut oak	14	14
Other white oaks	12	13
Northern red, swamp red & shumard oak	9	12
Other red oaks	10	12
Hickory	12	12
Ash	16	20
Other hard hardwoods	13	14

Table 9.--Percent of the total volume of large sawtimber in grade 1 and 2 logs, by species

Species	Large sawtimber
	Percent
Blackgum	47
Yellow-poplar	42
Sweetgum	34
Soft maple	20
Other soft hardwoods	36
White & swamp chestnut oak	50
Other white oaks	45
Northern red, swamp red & shumard oak	39
Other red oaks	32
Hickory	27
Ash	48
Other hard hardwoods	44

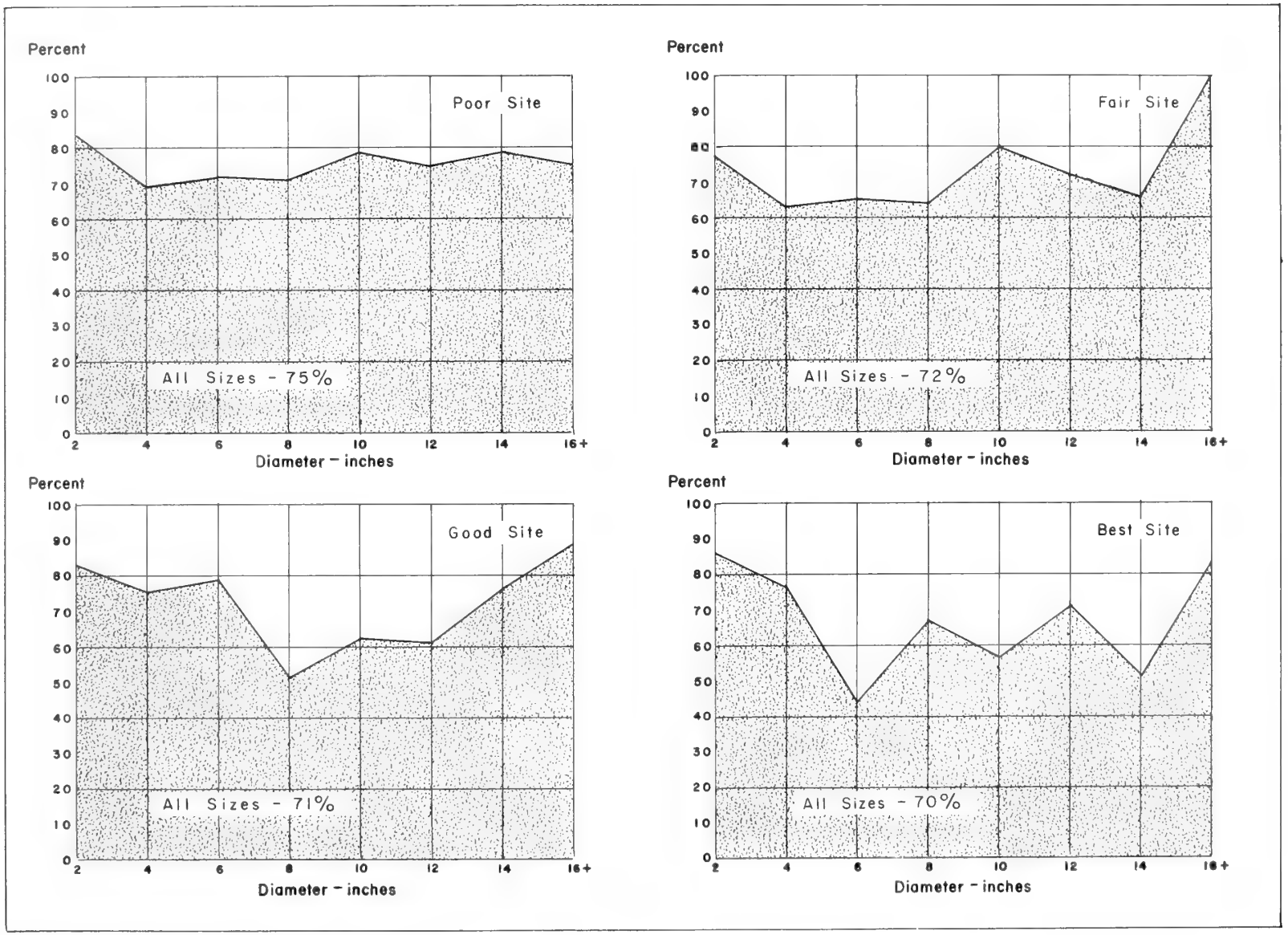


Figure 19.--Hardwood basal area as a percent of total basal area in oak-shortleaf pine type, by site and size of timber.

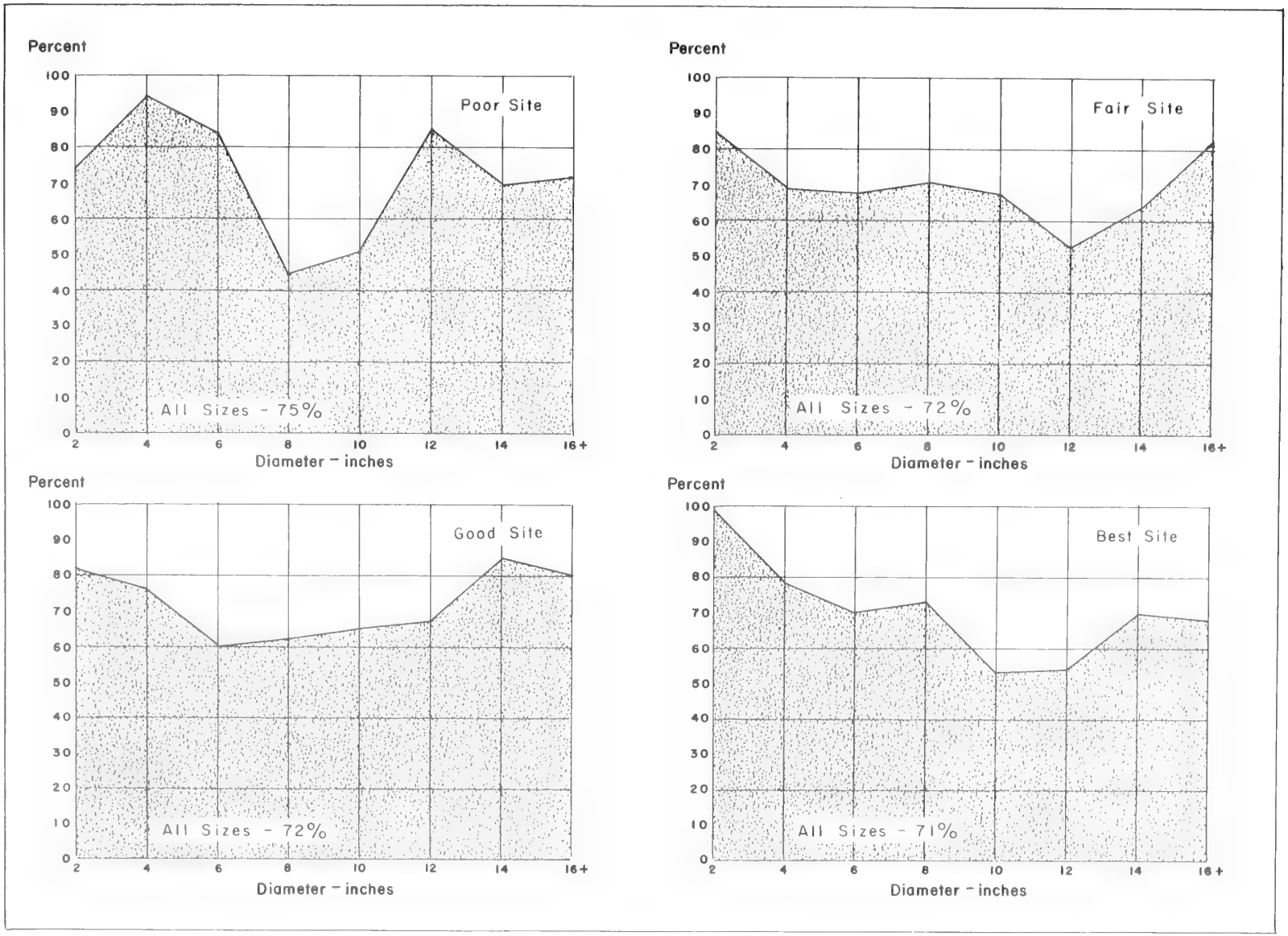


Figure 20.--Hardwood basal area as a percent of total basal area in oak-loblolly pine type, by site and size of timber.

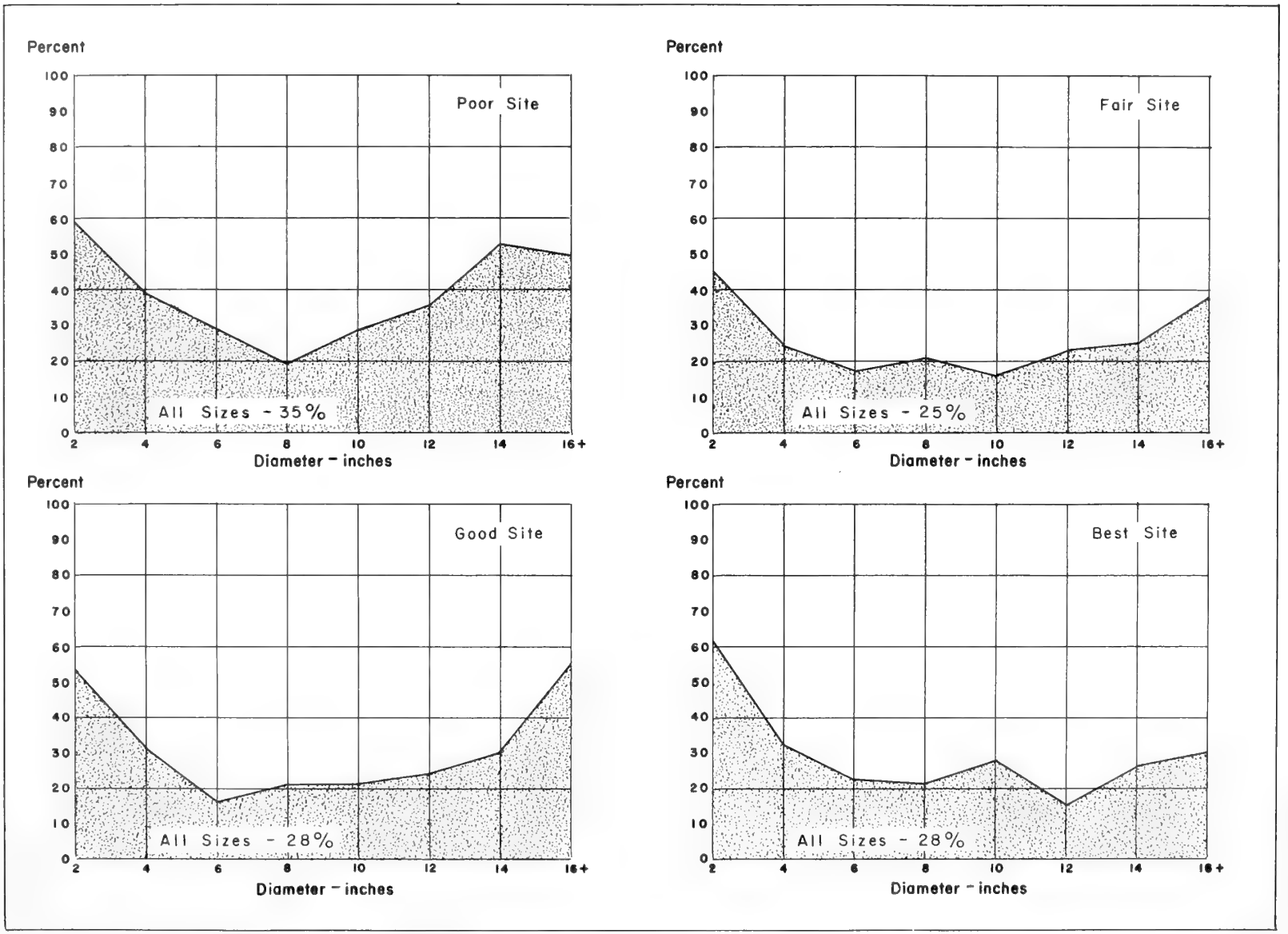


Figure 21.--Hardwood basal area as a percent of total basal area in shortleaf pine type, by site and size of timber.

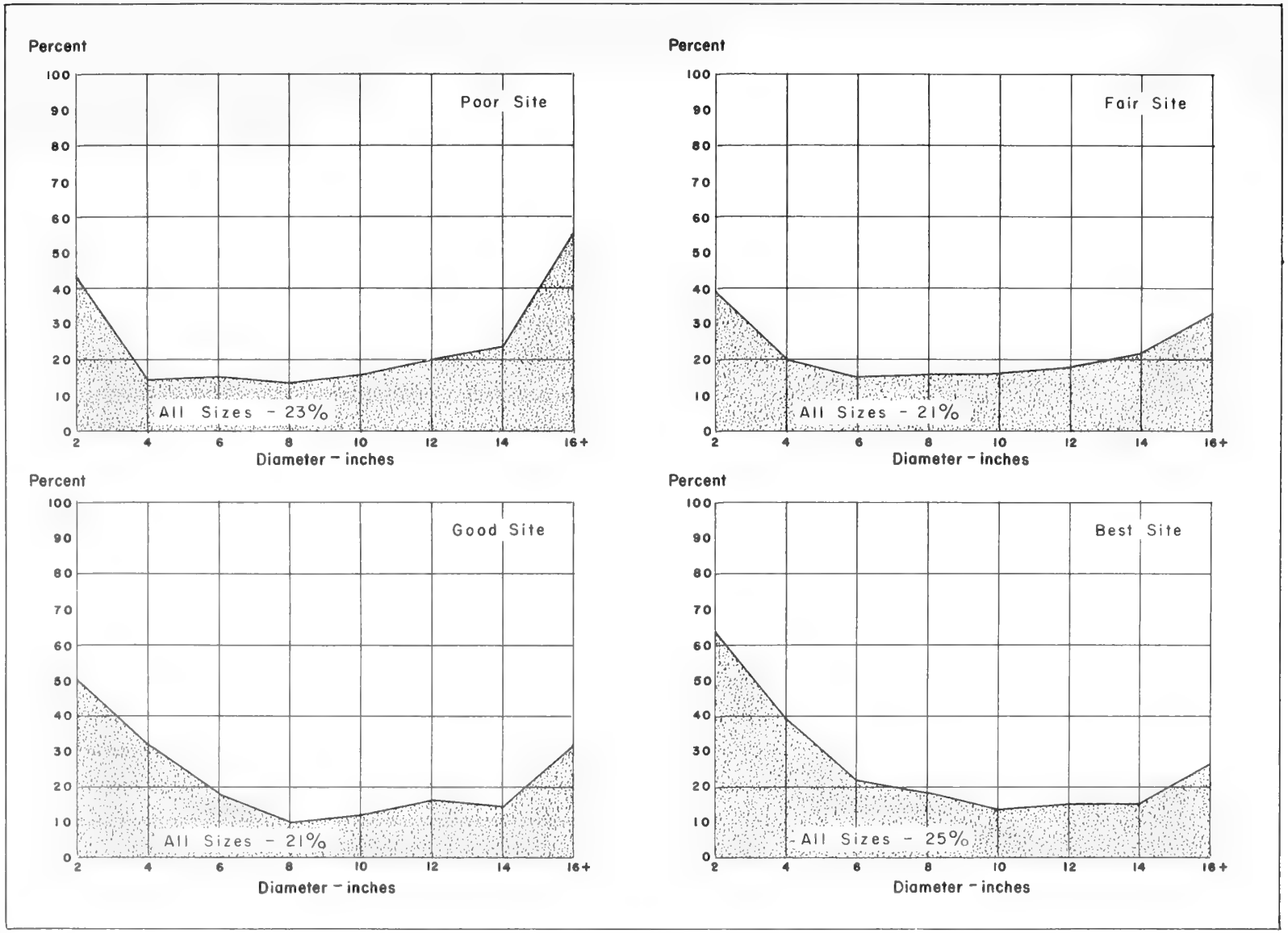


Figure 22.--Hardwood basal area as a percent of total basal area in loblolly pine type, by site and size of timber.

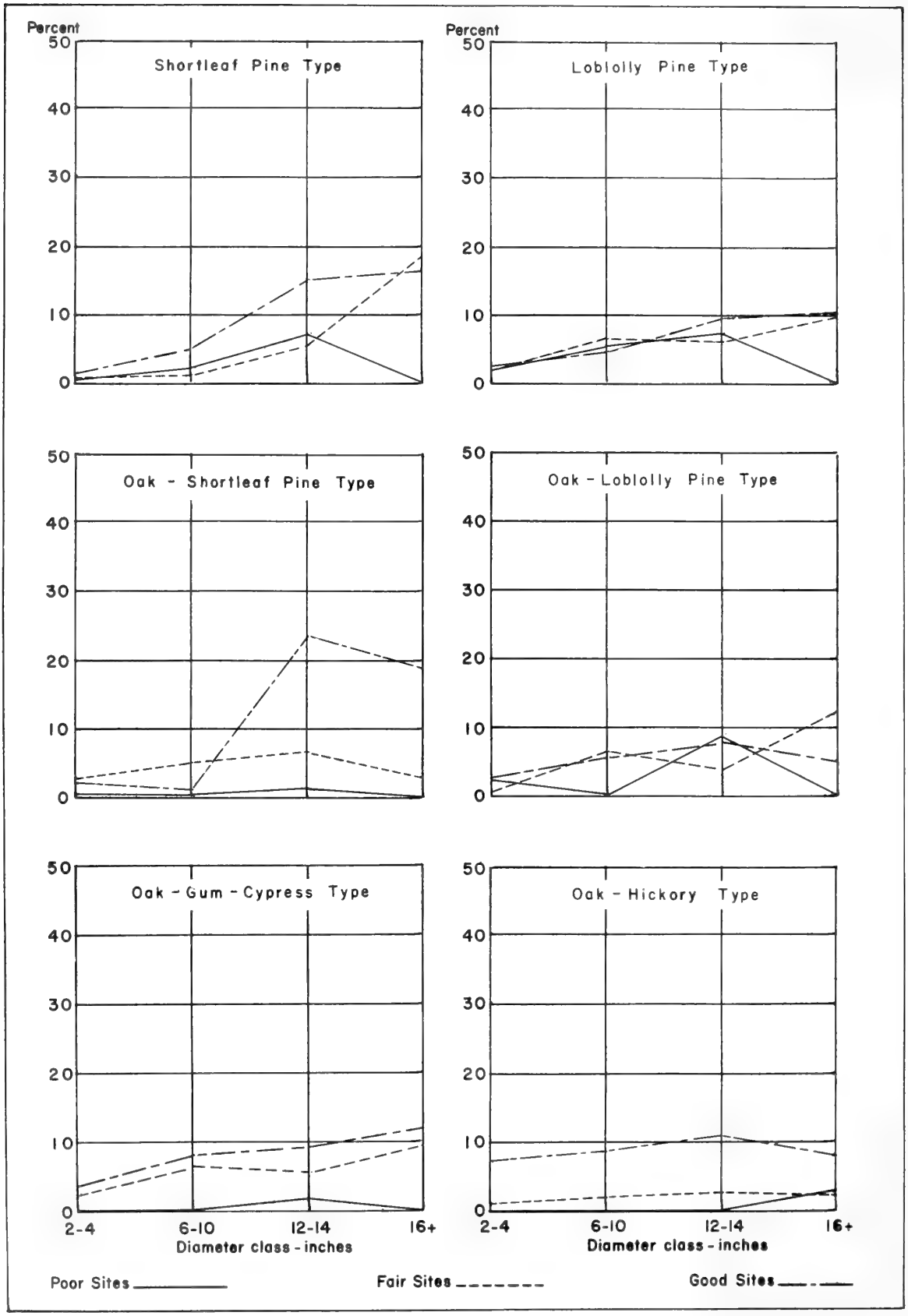


Figure 23.--Percent of the number of trees that are yellow-poplar, by forest type, site quality, and size of timber.

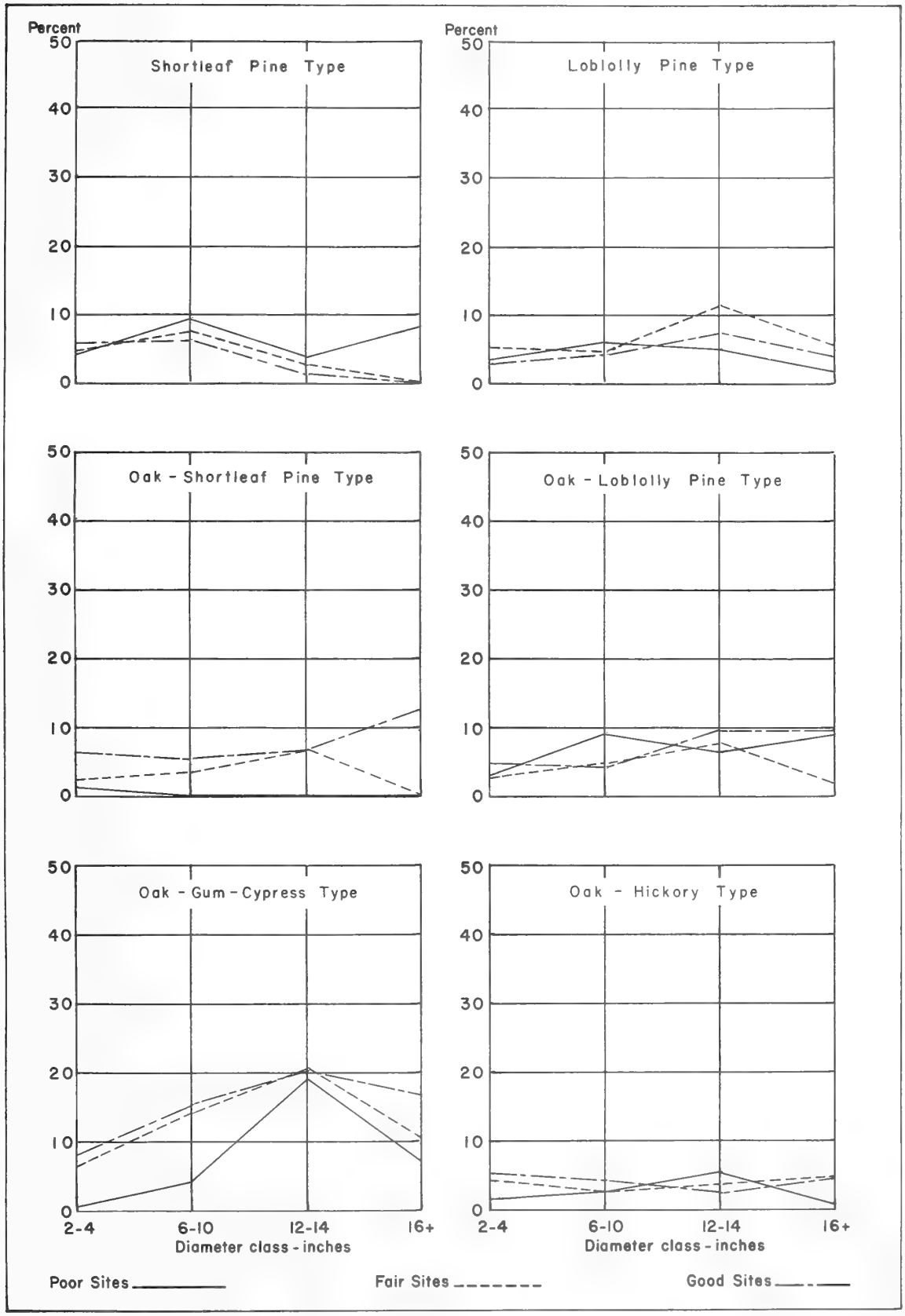


Figure 24.--Percent of the number of trees that are blackgum, by forest type, site quality, and size of timber.

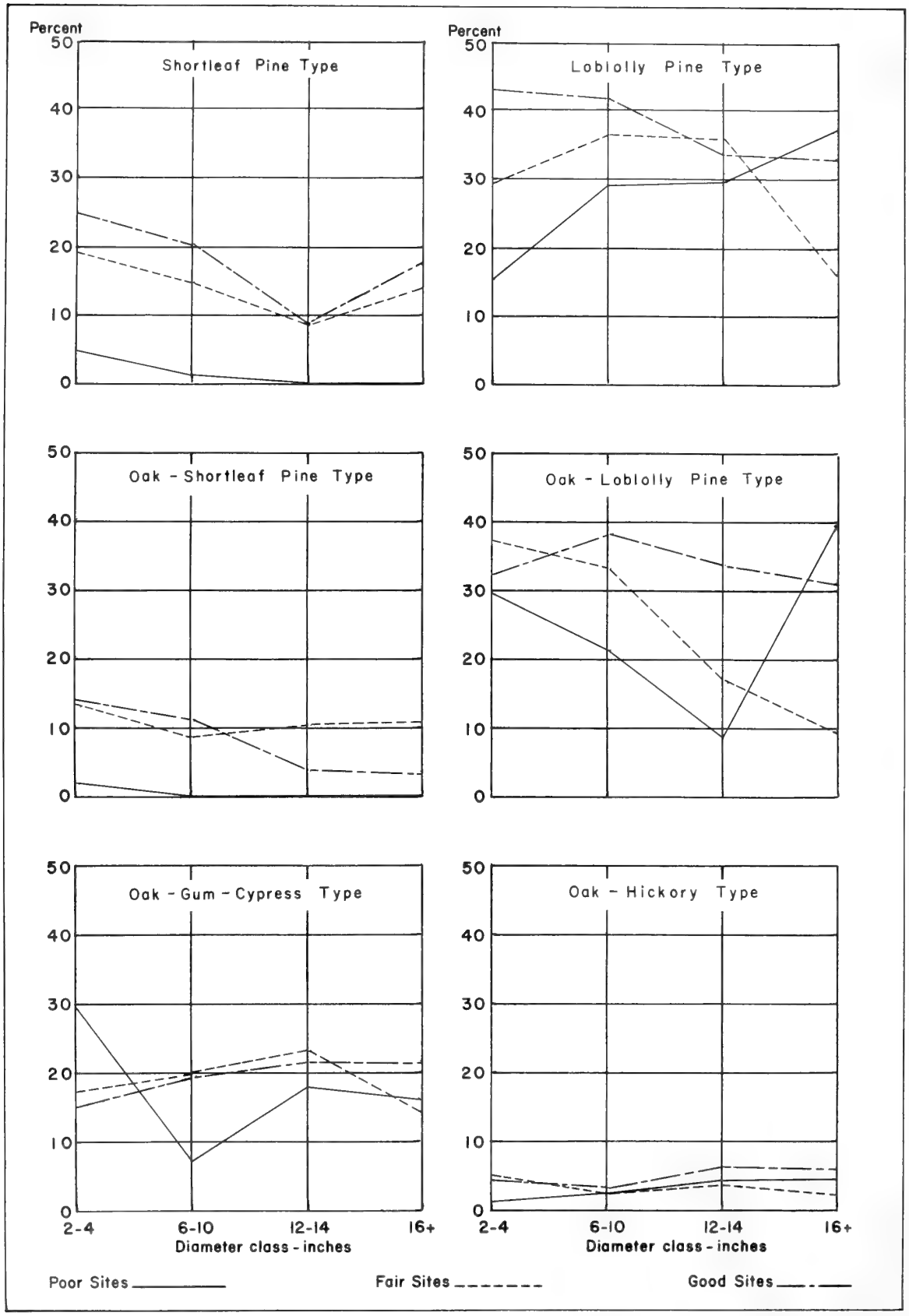


Figure 25.--Percent of the number of trees that are sweetgum, by forest type, site quality, and size of timber.

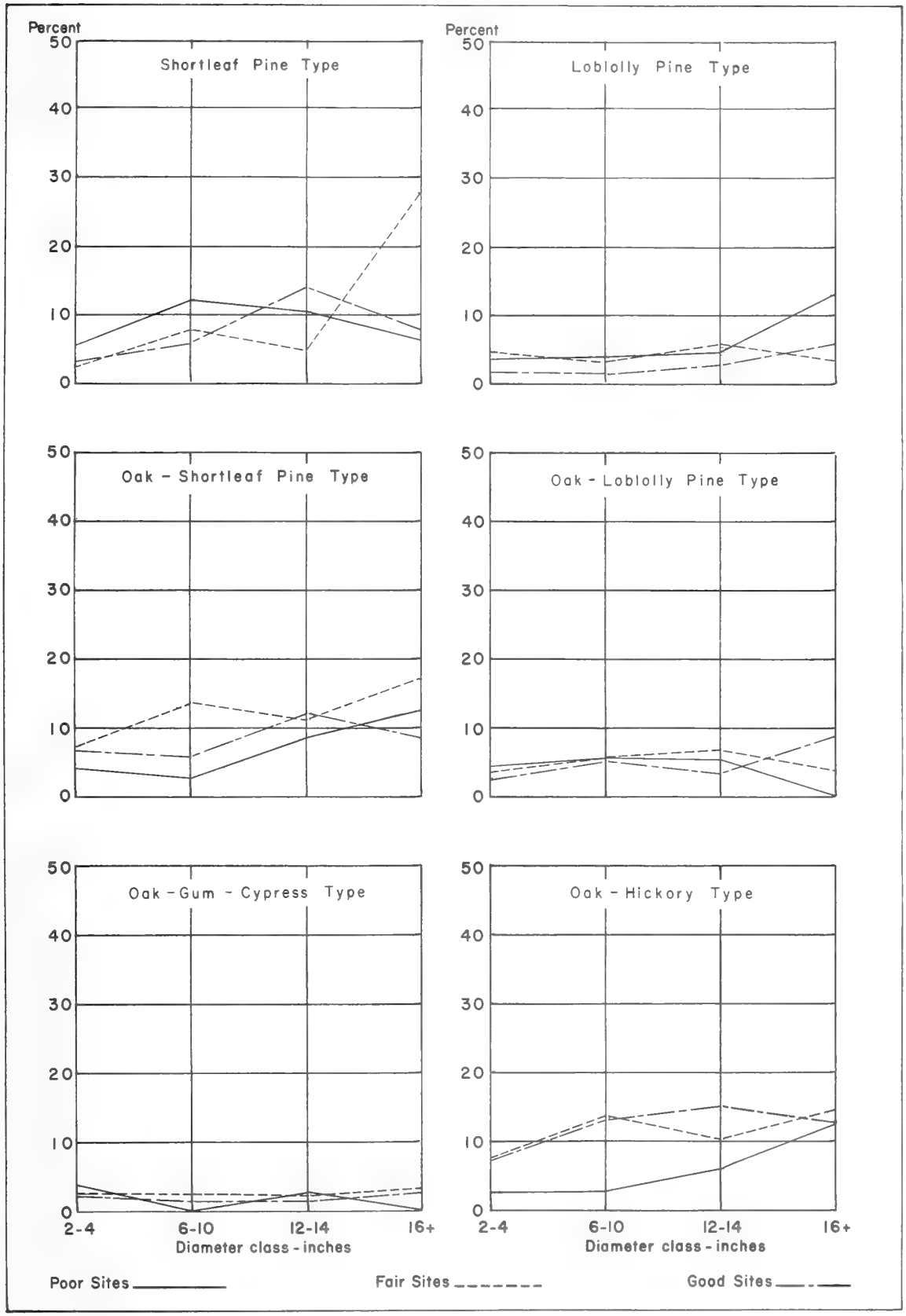


Figure 26.--Percent of the number of trees that are desirable white oaks, by forest type, site quality, and size of timber.

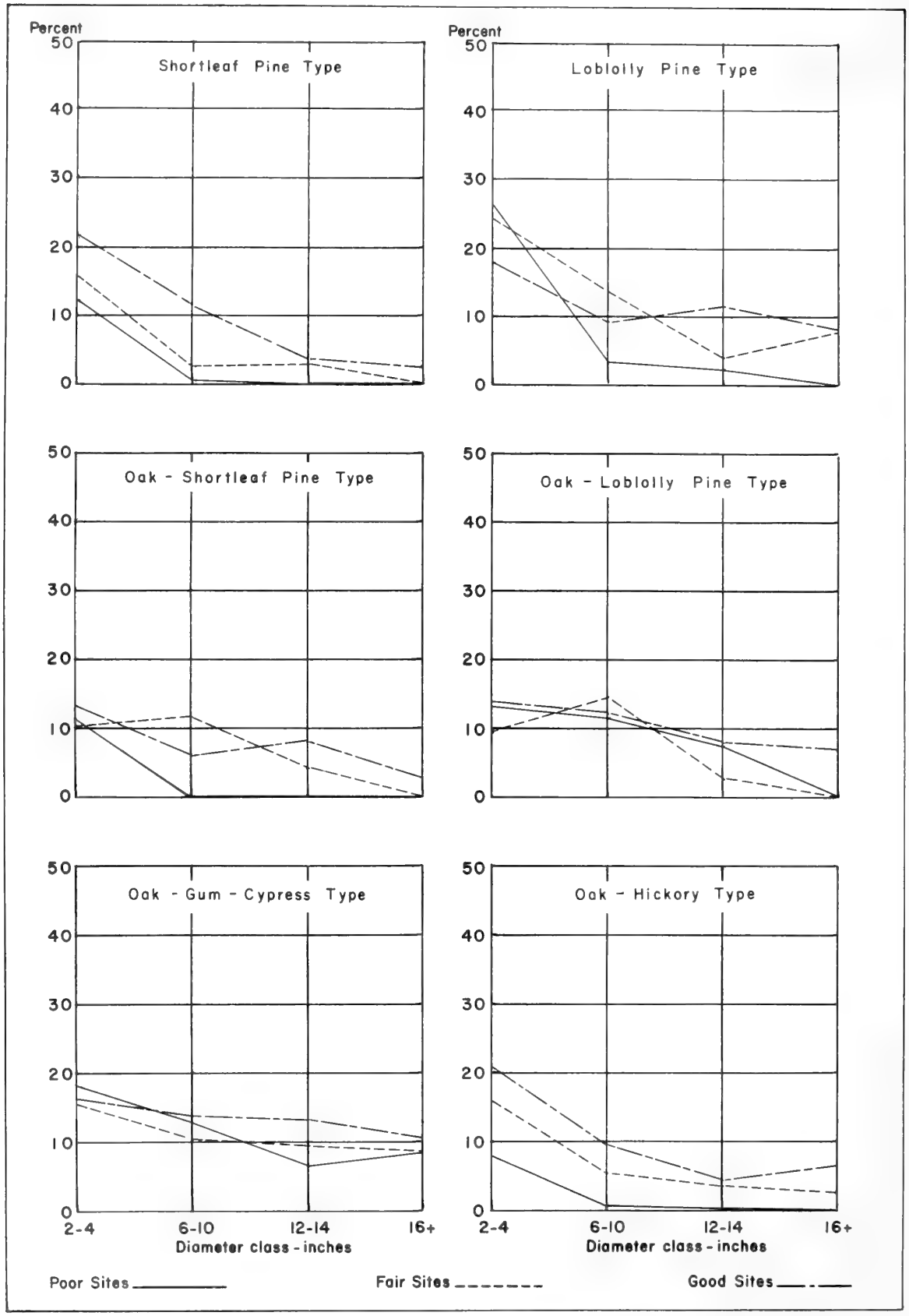


Figure 27.--Percent of the number of trees that are miscellaneous hard hardwoods, by forest type, site quality, and size of timber.

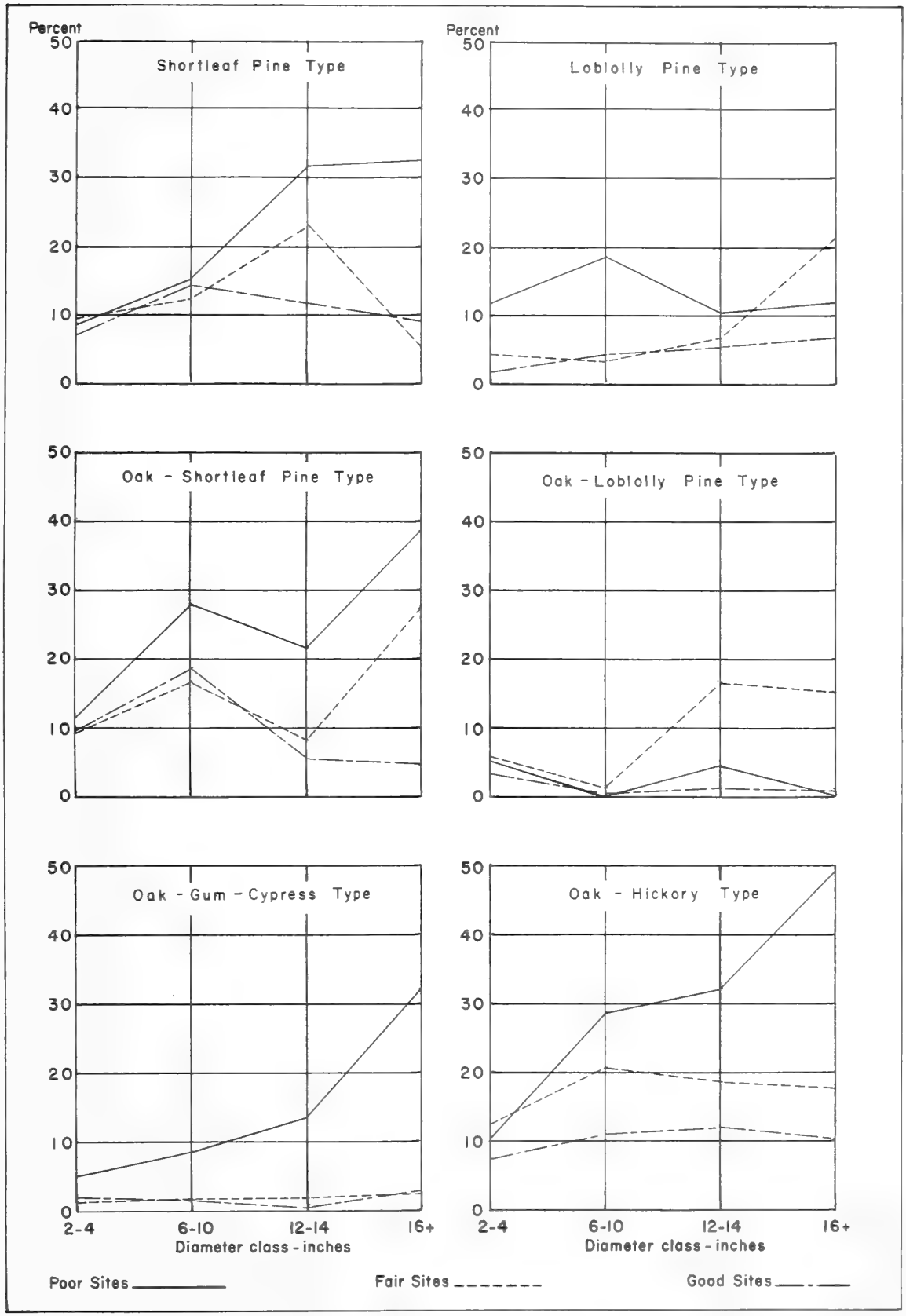


Figure 28.--Percent of the number of trees that are less desirable white oaks, by forest type, site quality, and size of timber.

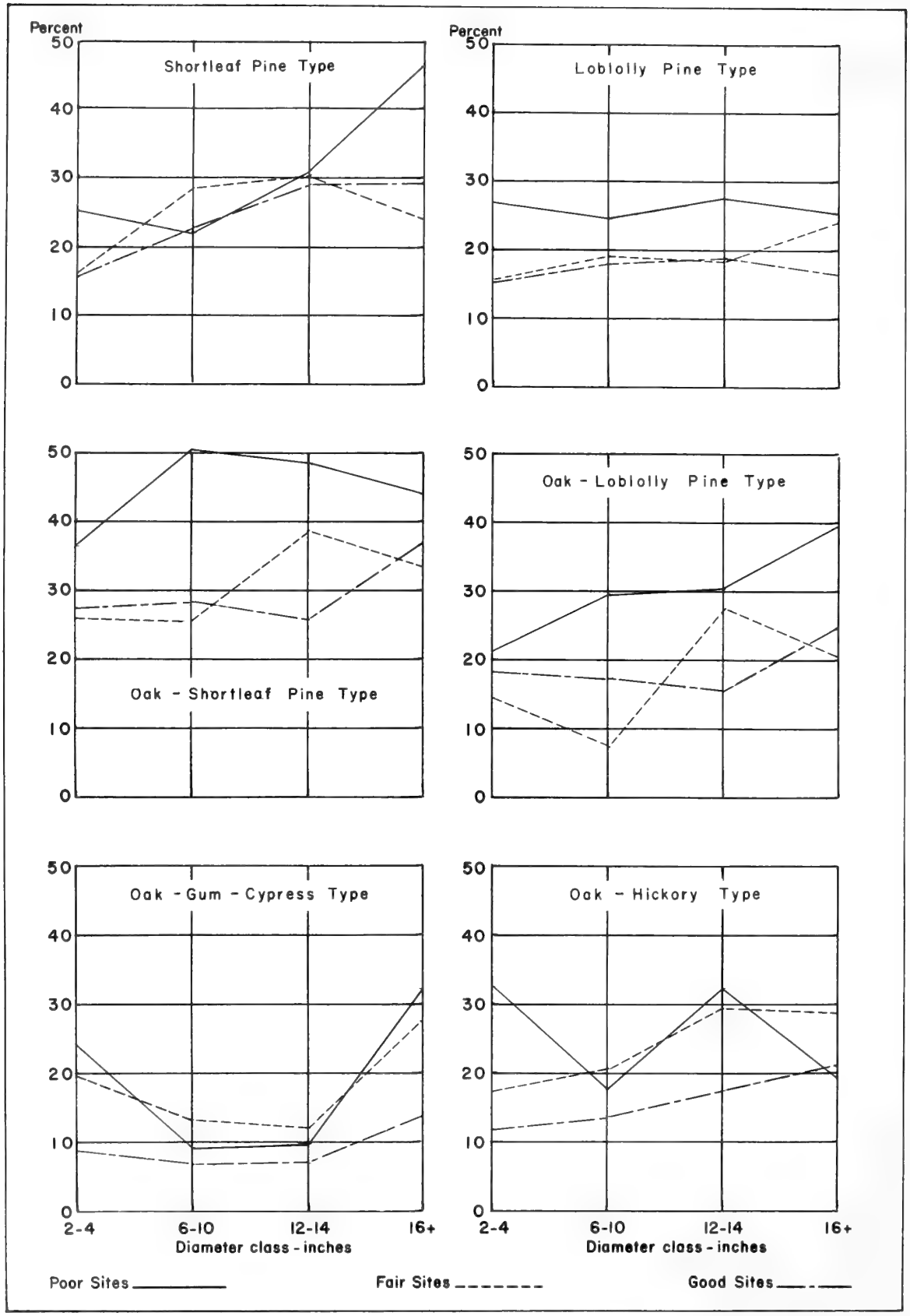


Figure 29.--Percent of the number of trees that are less desirable red oaks, by forest type, site quality, and size of timber.

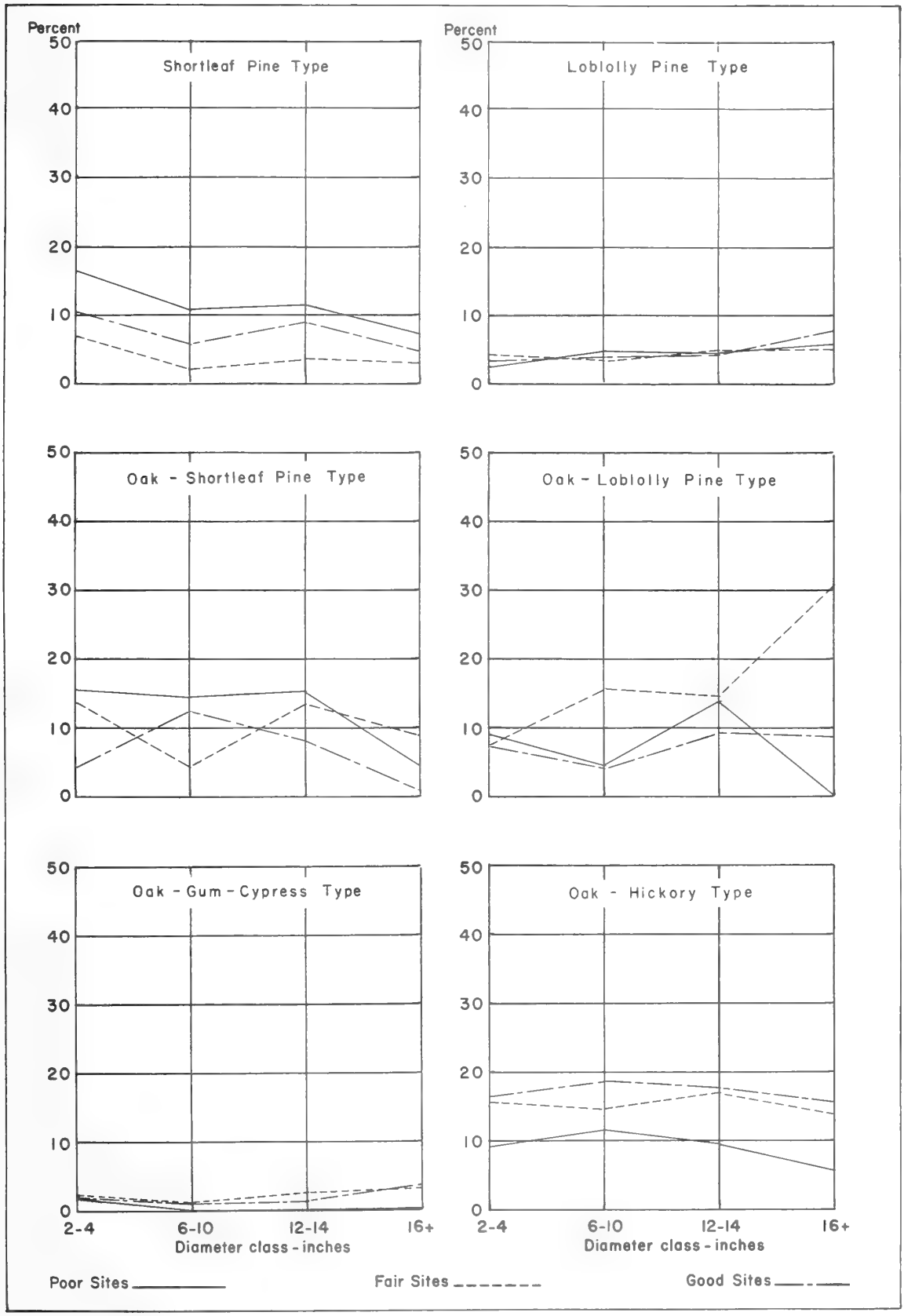


Figure 30.--Percent of the number of trees that are hickory, by forest type, site quality, and size of timber.

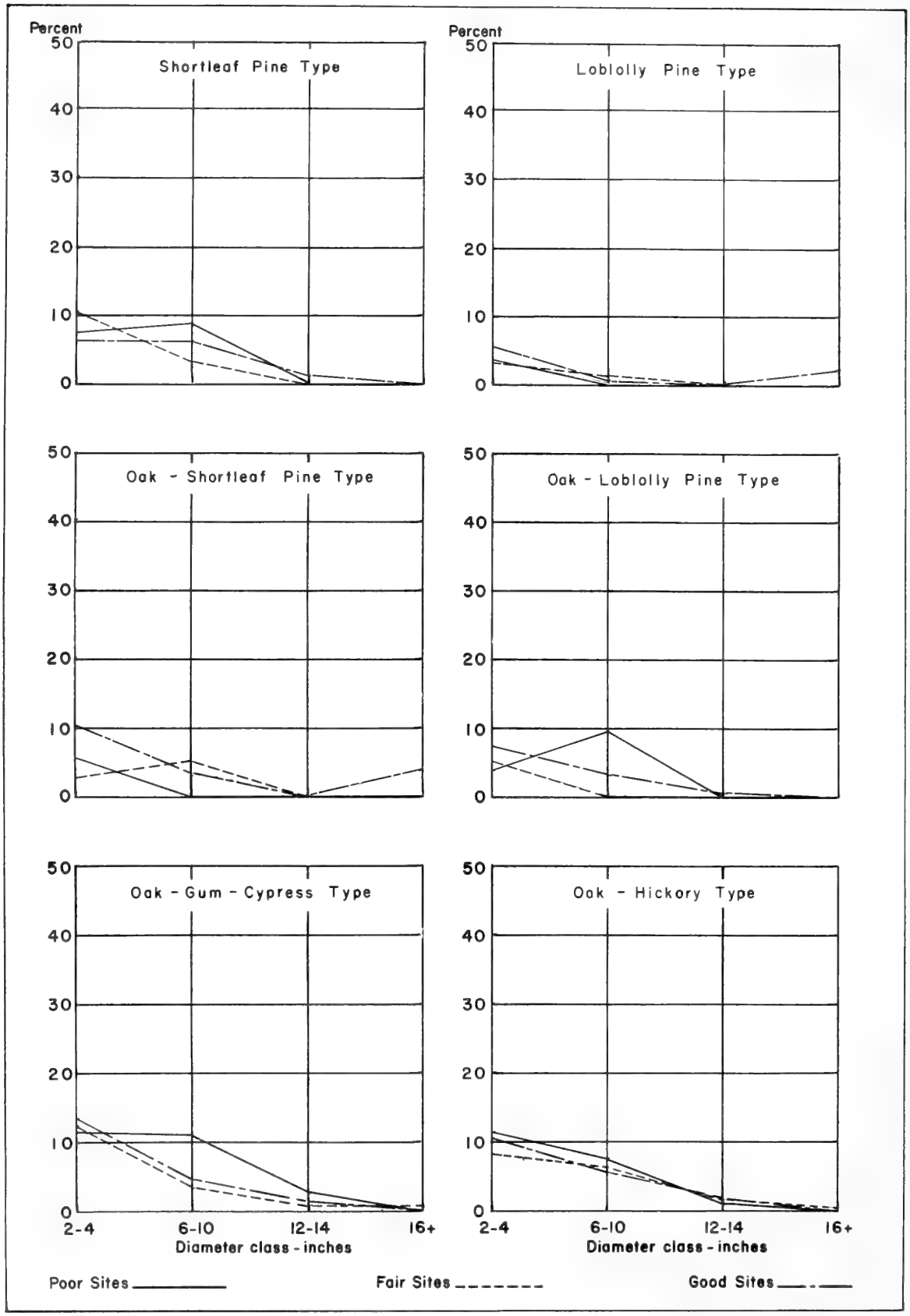


Figure 31.--Percent of the number of trees that are miscellaneous noncommercial species, by forest type, site quality, and size of timber.

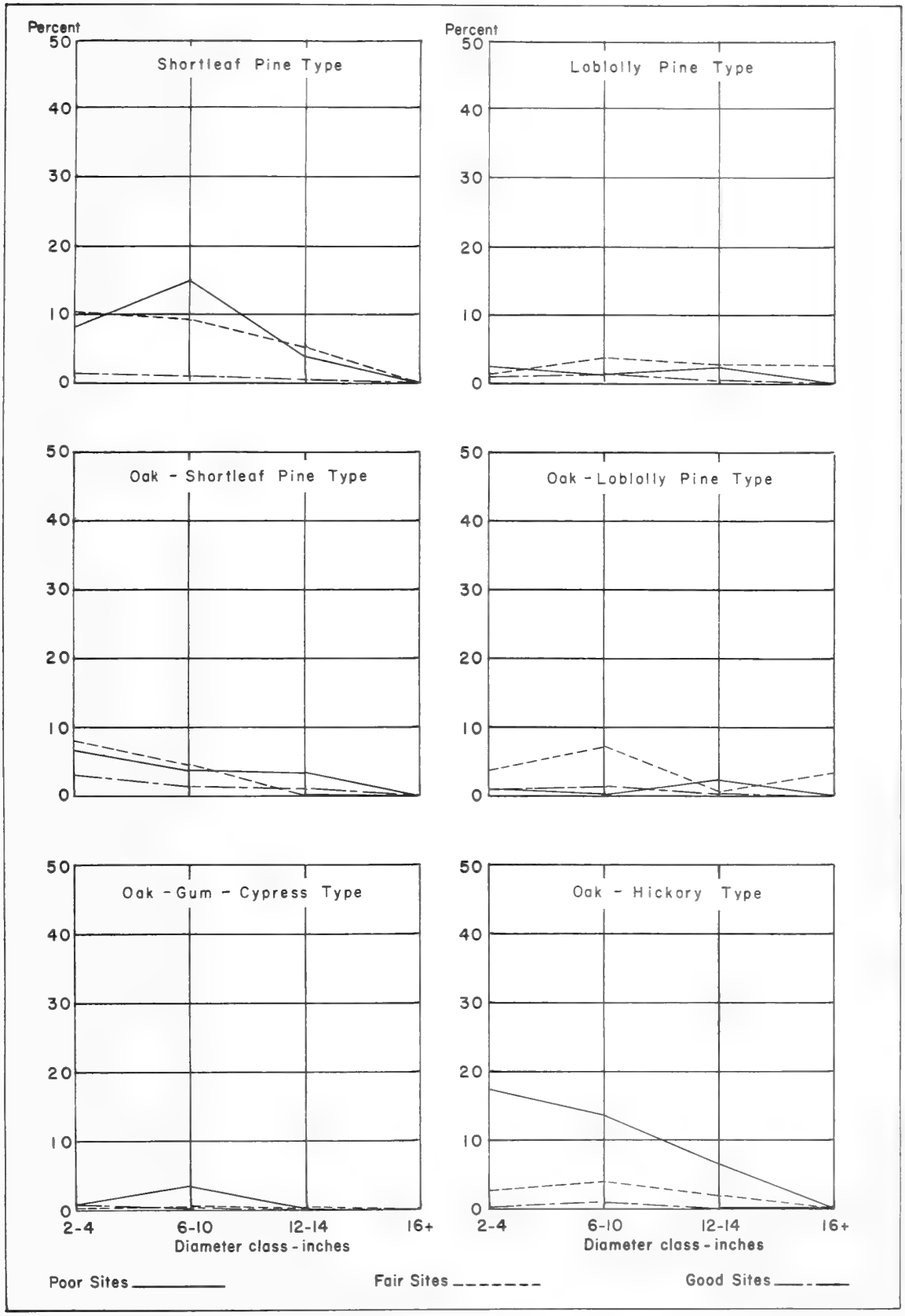


Figure 32.--Percent of the number of trees that are scrub oak, by forest type, site quality, and size of timber.

CONCLUSIONS

Landowners in central and north Georgia are faced with a rapidly increasing surplus of unmarketable hardwood timber and a decreasing supply of the pine and the large high-quality gum and yellow-poplar in great demand by forest industries. This abundance of low-quality hardwoods is not due to the inability of the forest land to support high-quality hardwoods, but to the long-standing practice of selecting the better trees for cutting and leaving the less desirable. At least 60 percent of the land in this area is capable of growing good quality hardwoods. Further study may show that additional areas will grow good quality hardwoods under proper management.

The ideal solution to the problem of surplus hardwoods is to find profitable use for them. However, at present the prospects of developing markets for any appreciable quantity of these hardwoods are not especially promising. Just to cut the growth of oak and hickory growing stock would mean cutting two and a half times the volume of oak and hickory now being cut. Practically all of this cut would have to come from trees 14 inches and smaller, as there is only a small excess of growth over cut in trees 15 inches and larger. Also, most of this cut would have to come from the least desirable species. Nearly half the oak and hickory volume consists of the less desirable oak such as chestnut oak, post, black, scarlet, southern red, and water oak. Fourteen percent is hickory.

In addition, there are the cull hardwoods, which for all practical purposes are not being used at all at the present time. Just to keep the volume of these cull hardwoods from increasing would mean cutting over a million cords annually--more than the volume of pine cut for pulpwood in this region in 1954. In addition to the annual growth, there is the present volume of nearly 30 million cords of cull hardwoods which should be removed from the stands to make room for better timber.

Use for fibre appears to offer the best prospects for utilizing enough of this surplus material to affect the trend. However, in 1954, only about 8,000 cords of hardwood timber were cut for pulpwood, and most of these were gum and yellow-poplar. Not all the cull timber is suitable for pulpwood; much of the volume is in large, rough, limby trees costly to log. It is estimated that not more than half the volume of cull timber is potentially suitable for pulpwood under existing logging methods. Counting half the growth on the culls and all the surplus growth on the poletimber, this region has about $1\frac{1}{2}$ million cords of hardwood timber available for pulpwood from current annual growth alone, or enough to supply several large pulp mills.

In the meantime, while landowners are waiting for markets to develop, they have the choice of girdling, poisoning, or in some way destroying these unwanted hardwoods or allowing them to take over more and more of the available growing space on their forest land.

DEFINITION OF TERMS

Land-Use Classes

Forest land: Includes (a) lands which are at least 10 percent stocked with trees of any size and capable of producing sawtimber or other wood products, and (b) lands from which the trees described in (a) have been removed to less than 10-percent stocking but which have not been developed for other use.

Forest Types

Forest type is determined on the basis of cubic volume for all stand sizes except seedlings and saplings (stand size 4), in which case the number of stems are the criteria.

Pine types: Forests in which 50 percent or more of the stand is in pine species. Plurality of volume or number of trees is used to determine the specific type.

Oak-pine type: Forests in which 50 percent or more of the stand is hardwood, usually upland oaks, but in which southern yellow pines make up 25-49 percent of the stand.

Oak-hickory type

Upland hardwood: Forests in which 50 percent or more of the stand is composed of upland oak, hickory, yellow-poplar, maple, gum, and other hardwoods, except where pines comprise 25-49 percent of the stand.

Scrub oak: Upland forests in which 50 percent or more of the stand is composed of scrub oak species, except where pines comprise 25-49 percent of the stand.

Oak-gum-cypress type

Lowland hardwood: Bottomland forests in which 50 percent or more of the stand is tupelo, blackgum, sweetgum, ash, oak, elm, maple, and associated species, except where pines comprise 25-49 percent of the stand.

Cypress: Bottomland forests in which 50 percent or more of the stand is cypress, except where pines comprise 25-49 percent of the stand.

Stand-Size Classes

Sawtimber: Stands containing at least 1,500 board-feet net volume per acre, $\frac{1}{4}$-inch log rule, in sound, live, softwood trees 9.0 inches d.b.h. or larger, or hardwood trees 11.0 inches d.b.h. or larger. Two classes of sawtimber stands are recognized:

Large sawtimber: Stands of sawtimber having more than 50 percent of the net board-foot volume in trees 15.0 inches d.b.h. or larger.

Small sawtimber: Stands of sawtimber having 50 percent or less of the net board-foot volume in trees 15.0 inches d.b.h. or larger.

Poletimber: Stands failing to meet the minimum sawtimber specifications, but at least 10-percent stocked with trees 5.0 inches d.b.h. or larger and with at least half the minimum stocking in pole-size trees.

Seedlings and saplings: Stands not qualifying as sawtimber or poletimber stands, but having at least a 10-percent stocking of trees of commercial species and with half the minimum stocking in seedlings and saplings.

Nonstocked and other areas: Forest areas not qualifying as sawtimber, poletimber, or seedling and sapling stands.

Diameters

D.b.h. (diameter at breast height): Stem diameter in inches, outside bark, measured at $4\frac{1}{2}$ feet above the ground.

Diameter class: All trees were tallied by 2-inch diameter classes, each class including diameters 1.0 inch below and 0.9 inch above the stated midpoint, e.g., trees 7.0 to and including 8.9 inches are included in the 8-inch class. Corresponding limits apply to other diameter classes.

Timber Quality Classification

Growing Stock

Sawtimber trees: Live softwood trees at least 9.0 inches d.b.h. and hardwood trees at least 11.0 inches d.b.h., with not less than one merchantable log 12 feet long, or with less than 50 percent of the gross volume of the tree in sound sawtimber.

Poletimber trees: Straight-boled trees between 5.0 inches d.b.h. and sawtimber size.

Sapling-size trees: Trees 1.0 inch to 4.9 inches d.b.h. which will grow into poletimber or sawtimber size trees of sound quality.

Other Material

Sound cull trees: Live trees of all sizes that are unmerchantable for saw logs now or prospectively because of species, poor form, excessive limbiness, or other sound defect.

Rotten cull trees: Live trees of all sizes that are unmerchantable for saw logs now or prospectively because of rotten defect.

Hardwood limbs: The limb volume of all hardwood sawtimber and cull trees to a minimum diameter of 4.0 inches inside bark.

Species Groups

Yellow pines: Includes longleaf, slash, loblolly, pond, and shortleaf pine.

Other softwoods: Pondcypress, baldcypress, and eastern redcedar.

Gum and yellow-poplar: Includes black and tupelo gum, yellow-poplar, sweetgum, and other soft hardwoods such as cottonwood, soft maple, basswood, magnolia, sweetbay, and willow.

Oak and hickory: Includes all of the oaks, hickories, and other hard hardwoods such as ash, beech, elm, river birch, hackberry, sycamore, black locust, mulberry, black walnut, holly, dogwood, and persimmon.

Volume Estimates

Board-foot volume: The volume in board-feet, measured by the International $\frac{1}{4}$-inch rule, exclusive of defect, of that portion of sound sawtimber trees between the stump and the upper limit of merchantability for saw logs.

Volume in cords: For sound trees the volume in standard cords (including bark) of the sound portion of trees 5.0 inches d.b.h. and larger, between stump and a minimum top-stem diameter of 4.0 inches inside bark. Similar volumes are given for cull trees. The volume in limbs, in sections 4 feet long and at least 4.0 inches in diameter inside bark, of all sawtimber-size hardwoods is shown separately.

Volume in cubic feet: Same as volume shown in cords except bark is not included.

International $\frac{1}{4}$-inch log rule: A rule for estimating the board-foot volume of 4-foot log sections, according to the formula $V = .905\ (0.22D^2 - 0.71D)$. The taper allowance for computing the volume in log lengths greater than 4 feet is 0.5 inch per 4-foot section. Allowance for saw kerf is $\frac{1}{4}$ inch.

Standard cord: A stacked pile, 4 x 4 x 8 feet, of round or split bolts, estimated to contain on the average about 73 cubic feet of solid wood.

Stocking

Stocking is the extent to which growing space is effectively utilized by trees of growing stock quality. The number of stems present by d.b.h. classes was used as a basis for stocking classification. Areas having the minimum numbers of trees listed on the following page, either in a single diameter class or proportionately in any combination of diameter classes, were considered fully stocked.

D.b.h.	Minimum number trees per acre
Seedlings	1,000
2 inches	800
4 inches	590
6 inches	400
8 inches	240
10 inches	155
12 inches	115
14 inches	90

Growth

Net growth: The estimated volume of net growth includes the growth on the present growing stock plus the ingrowth accrual resulting from smaller trees reaching volume size. It excludes mortality, or loss of volume in trees dying from natural causes. Net growth estimates are based on the volume or number of sound trees. Other material is not included.

In board feet: The change during the calendar year in sawtimber volume resulting from growth, ingrowth, and mortality losses.

In cubic feet or cords: The change during the calendar year in the volume of all sound trees 5.0 inches and larger resulting from growth, ingrowth, and mortality losses.

Timber Cut

The volume of timber cut is based on the measurement and tally of stumps found on regular ground sample plots. Stumps of all trees cut during the past 3-year period are recorded and the measurements are converted into equivalent tree volume. The average volume of timber cut for the 3-year period is then taken as the annual estimate. Board-foot cut volumes include the saw-log portion of all sawtimber size trees which were cut. Timber cut in cubic feet or cords includes the entire stem from stump to 4.0-inch top of all sound trees 5.0 inches in diameter and larger.

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